



# Kathir College of Engineering

[An Autonomous Institution]

[Approved by AICTE | Affiliated to Anna University | Accredited by NAAC with 'A+' Grade]

Wisdom Tree, Avinashi Road, Neelambur, Coimbatore 641062



## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (AIML) CURRICULUM & SYLLABUS REGULATION 2024



**5<sup>th</sup> & 6<sup>th</sup> Semester**

**BATCH: 2024-28, 2025-29**

**CREDITS: 170**

| S.No                              | CONTENTS                                                           | Pg.No |
|-----------------------------------|--------------------------------------------------------------------|-------|
| 1.                                | Institution Vision, Mission, Goals and Quality policy              | 1     |
| 2.                                | Department Vision, Mission and Program Educational Objective (PEO) | 2     |
| 3.                                | Program Outcomes (PO)                                              | 3     |
| 4.                                | Program Specific Outcomes (PSOs)                                   | 5     |
| 5.                                | Scheme of Credit and Course Distribution                           | 6     |
| 6.                                | Curriculum                                                         | 7     |
| 7.                                | Professional Elective Courses                                      | 10    |
| 8.                                | Mandatory Courses                                                  | 11    |
| 9.                                | Open Elective Courses                                              | 11    |
| 10.                               | Humanities Sciences                                                | 11    |
| 11.                               | Basic Sciences                                                     | 12    |
| 12.                               | Engineering Sciences                                               | 12    |
| 13.                               | Program Core                                                       | 13    |
| 14.                               | List of Professional Elective Courses                              | 13    |
| 15.                               | Industry Practices                                                 | 15    |
| 16.                               | Project work                                                       | 15    |
| <b>SCHEME</b>                     |                                                                    |       |
| 17.                               | Scheme of Fifth and Sixth Semester                                 | 16    |
| <b>SYLLABUS</b>                   |                                                                    |       |
| <b>Syllabus of Fifth Semester</b> |                                                                    |       |
| 18.                               | THEORY OF COMPUTATION                                              | 18    |
| 19.                               | CYBER SECURITY                                                     | 20    |
| 20.                               | COMPUTER NETWORKS                                                  | 22    |
| 21.                               | BASICS OF DRONE TECHNOLOGY                                         | 25    |
| 22.                               | BIG DATA ANALYTICS                                                 | 28    |
| 23.                               | Deep learning for Vision                                           | 31    |
| 24.                               | Natural Language Processing                                        | 34    |
| <b>Syllabus of Sixth Semester</b> |                                                                    |       |
| 25.                               | ARTIFICIAL INTELLIGENCE-II                                         | 37    |
| 26.                               | PRINCIPLES OF MANAGEMENT                                           | 40    |
| 27.                               | QUANTUM COMPUTING                                                  | 43    |
| <b>Professional Electives</b>     |                                                                    |       |
| 28.                               | Analytics Engineering                                              | 47    |
| 29.                               | Full Stack Development                                             | 55    |
| 30.                               | Cloud Computing and Data Center Technologies                       | 68    |
| 31.                               | Emerging Technologies                                              | 81    |
| 32.                               | Language Modelling                                                 | 92    |
| <b>Open Electives</b>             |                                                                    |       |
| 33.                               | Open Elective Courses offered by AI&DS to other Departments        | 107   |
| 34.                               | Open Elective courses offered to AI&DS by other Departments        | 118   |
| <b>Appendix</b>                   |                                                                    |       |
| 35.                               | Appendix A: List of Program Outcomes                               | 191   |
| 36.                               | Appendix B: Bloom's Taxonomy                                       | 191   |





# Kathir College of Engineering

[ Autonomous ]

[Approved by AICTE | Affiliated to Anna University | Accredited by NAAC with 'A+' Grade]

Wisdom Tree, Avinashi Road, Neelambur, Coimbatore 641062

Phone: 0422-2203787 | Fax:08030723600 | Email: kathirce@gmail.com | Web: www.kathir.ac.in



## INSTITUTE VISION AND MISSION

### VISION

Strive to promote Excellence in Engineering Education and Research by developing our students as Real-Time Problem solvers thereby contributing to the Societal needs

### MISSION

- Promote excellence in Core and allied studies through Technology enabled Teaching and active learning practices
- Develop multi-talented and committed human resources by providing research and development environment to innovate and find solutions for Real-Time Problems.
- Create socially responsible engineers with team-spirit/entrepreneurs with necessary leadership skills thus contributing towards a better world.

### CORE VALUES

- Our motto is to serve the society through producing responsible citizens by imparting integrity and ethics
- We strongly believe in inclusivity and consider every stakeholder as responsible to set benchmark in each of our activities
- Our faculty member exhibit excellent team-spirit and achieve excellence in each of our curricular, co-curricular and extra-curricular activities.
- We see every student of our Institution as a problem solver and our start-up studios help them to become entrepreneurs and provide solutions for the societal needs
- We promote the sense of social responsibilities in students by providing ample opportunities to participate in various social activities
- We create an eco-system where every faculty member and student accepts responsibility for personal and professional growth and development

## REGULATIONS 2024

### CHOICE BASED CREDIT SYSTEM

#### B.E. COMPUTER SCIENCE AND ENGINEERING(AIML)

##### I.VISION

To empower students with the latest skills in the ever-changing field of Computer Science & Engineering supplemented with practical orientation to meet the growing needs of the modern computing industry and society

##### II.MISSION

- To achieve academic excellence by providing fundamental concepts and advanced technologies in the field of Computer Science and Engineering.
- Motivate the students to update with the latest computer technologies to succeed in the ever-changing world.
- To provide holistic education to practice the chosen profession ethically with leadership quality.

##### III.PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates can apply their technical competence in computer science to solve real world problems, with technical and people leadership.
2. Graduates can conduct cutting edge research and develop solutions on problems of social relevance.
3. Graduates can work in a business environment, exhibiting team skills, work ethics, adaptability and lifelong learning.

##### IV. PROGRAM OUTCOMES (POs)

- 1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**10.Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**11.Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## **V. PROGRAM SPECIFIC OUTCOMES (PSOs)**

- **PS01:** Design data structures and database management systems with a recurrent programming language to provide software solutions.
- **PS02:** In the fields of artificial intelligence, big data, and cloud computing, problem-solving techniques.

**SCHEME OF CREDIT DISTRIBUTION – SUMMARY**

| Stream                   | Credits/Semester |           |           |           |           |           |           |           | Credits    | AICTE      |
|--------------------------|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|
|                          | I                | II        | III       | IV        | V         | VI        | VII       | VIII      |            |            |
| Humanities Sciences (HS) | 3                | 3         |           |           |           | 3         | 2         |           | 11         | 12*        |
| Basic Sciences(BS)       | 8                | 8         | 4         | 4         |           |           |           |           | 24         | 25*        |
| Engineering Science(ES)  | 8                | 10        |           | 12        |           |           | 4         | NIL       | 34         | 24*        |
| Professional Core(PC)    |                  |           | 19        | 10        | 20        | 7         | 4         |           | 60         | 48*        |
| Program Electives(PE)    |                  |           |           |           | 3         | 3         | 9         |           | 15         | 18*        |
| Open Electives(OE)       |                  |           |           |           | 3         | 6         | 3         |           | 12         | 18*        |
| Project Work(PW)         |                  |           |           |           |           |           |           | 12        | 12         | 15*        |
| Industry Practices (IP)  |                  |           |           |           |           | 2         |           |           | 2          | -          |
| Mandatory Course (MC)    | -                | -         | -         | -         |           |           |           |           |            | -          |
| <b>Total</b>             | <b>19</b>        | <b>21</b> | <b>23</b> | <b>26</b> | <b>26</b> | <b>21</b> | <b>22</b> | <b>12</b> | <b>170</b> | <b>160</b> |

Minor variations are permitted by AICTE based on the need

**SCHEME OF COURSE DISTRIBUTION – SUMMARY**

| Stream                   | No. of Courses |          |          |           |          |          |          |          | Total No. of Courses |
|--------------------------|----------------|----------|----------|-----------|----------|----------|----------|----------|----------------------|
|                          | I              | II       | III      | IV        | V        | VI       | VII      | VIII     |                      |
| Humanities Sciences (HS) | 1              | 1        |          |           |          | 1        | 1        |          | 4                    |
| Engineering Sciences(ES) | 3              | 4        |          | 4         |          |          | 1        |          | 12                   |
| Basic Sciences(BS)       | 2              | 2        | 1        | 1         |          |          |          |          | 6                    |
| Professional Core(PC)    |                |          | 7        | 4         | 5        | 2        | 1        |          | 19                   |
| Program Electives(PE)    |                |          |          |           | 1        | 1        | 3        |          | 5                    |
| Open Electives(OE)       |                |          |          |           | 1        | 2        | 1        |          | 4                    |
| Project Work(PW)         |                |          |          |           |          |          |          | 1        | 1                    |
| Industry Practices (IP)  |                |          |          |           |          | 1        |          |          | 1                    |
| Mandatory Courses (MC)   | 1              | 1        | 1        | 1         |          |          |          |          | 4                    |
| <b>Total</b>             | <b>7</b>       | <b>8</b> | <b>9</b> | <b>10</b> | <b>7</b> | <b>7</b> | <b>7</b> | <b>1</b> | <b>56</b>            |

## CURRICULLUM

| SEMESTER I                  |             |                                      |                 |                  |           |            |          |
|-----------------------------|-------------|--------------------------------------|-----------------|------------------|-----------|------------|----------|
| S. No.                      | Course Code | Course                               | L/T/P           | Contact hrs/week | Credits   | Ext/Int    | Category |
| <b>THEORY</b>               |             |                                      |                 |                  |           |            |          |
| 1.                          | 24MA211     | Matrices and Calculus                | 3/1/0           | 4                | 4         | 60/40      | BS       |
| 2.                          | 24CS312     | Programming in C                     | 3/0/0           | 3                | 3         | 60/40      | ES       |
| <b>THEORY CUM PRACTICAL</b> |             |                                      |                 |                  |           |            |          |
| 3.                          | 24AC213     | Chemistry for Computing Sciences     | 3/0/2           | 5                | 4         | 40/60      | BS       |
| 4.                          | 24HS114     | Technical English                    | 2/0/2           | 4                | 3         | 40/60      | HS       |
| 5.                          | 24EG315     | Engineering Graphics                 | 1/0/4           | 5                | 3         | 40/60      | ES       |
| <b>PRACTICAL</b>            |             |                                      |                 |                  |           |            |          |
| 6.                          | 24CS316     | Programming in C Laboratory          | 0/0/4           | 4                | 2         | 40/60      | ES       |
| <b>MANDATORY COURSE</b>     |             |                                      |                 |                  |           |            |          |
| 7.                          | 24MC901     | Mandatory Course I Induction program | 3 weeks Program |                  | 0         | 0          | MC       |
| <b>Total</b>                |             |                                      | <b>12/1/12</b>  | <b>25</b>        | <b>19</b> | <b>600</b> |          |

| SEMESTER II                 |             |                                              |       |                  |         |         |          |
|-----------------------------|-------------|----------------------------------------------|-------|------------------|---------|---------|----------|
| S. No.                      | Course Code | Course                                       | L/T/P | Contact hrs/week | Credits | Ext/Int | Category |
| <b>THEORY</b>               |             |                                              |       |                  |         |         |          |
| 1.                          | 24MA221     | Differential Equations and Complex Functions | 3/1/0 | 4                | 4       | 60/40   | BS       |
| 2.                          | 24EE312     | Basic Electrical and Electronics Engineering | 3/0/0 | 3                | 3       | 60/40   | ES       |
| 3.                          | 24CS423     | Object Oriented Programming and Java         | 3/0/0 | 3                | 3       | 60/40   | ES       |
| <b>THEORY CUM PRACTICAL</b> |             |                                              |       |                  |         |         |          |

|                         |         |                                                 |                |           |           |            |    |
|-------------------------|---------|-------------------------------------------------|----------------|-----------|-----------|------------|----|
| 4.                      | 24HS124 | Professional English                            | 2/0/2          | 4         | 3         | 40/60      | HS |
| 5.                      | 24AP225 | Physics for Computing Sciences                  | 3/0/2          | 5         | 4         | 40/60      | BS |
| <b>PRACTICAL</b>        |         |                                                 |                |           |           |            |    |
| 6.                      | 24EP315 | Engineering Practices Laboratory                | 0/0/4          | 4         | 2         | 40/60      | ES |
| 7.                      | 24CS427 | Object Oriented Programming and Java Laboratory | 0/0/4          | 4         | 2         | 40/60      | ES |
|                         |         |                                                 |                |           |           |            |    |
| <b>MANDATORY COURSE</b> |         |                                                 |                |           |           |            |    |
| 8.                      | 24MC902 | Mandatory Course II Heritage of Tamils          | 2/0/0          | 2         | 0         | 0          | MC |
| <b>Total</b>            |         |                                                 | <b>16/1/12</b> | <b>29</b> | <b>21</b> | <b>700</b> |    |

| <b>SEMESTER III</b>         |             |                                           |       |                  |         |         |          |
|-----------------------------|-------------|-------------------------------------------|-------|------------------|---------|---------|----------|
| S. No.                      | Course Code | Course                                    | L/T/P | Contact hrs/week | Credits | Ext/Int | Category |
| <b>THEORY</b>               |             |                                           |       |                  |         |         |          |
| 1.                          | 24MA231     | Discrete Mathematics                      | 3/1/0 | 4                | 4       | 60/40   | BS       |
| 2.                          | 24AD432     | Artificial Intelligence                   | 3/0/0 | 3                | 3       | 60/40   | PC       |
| 3.                          | 24CS433     | Python Programming                        | 3/0/0 | 3                | 3       | 60/40   | PC       |
| 4.                          | 24CS346     | Data Structures and Algorithms            | 3/0/0 | 3                | 3       | 40/60   | PC       |
| <b>THEORY CUM PRACTICAL</b> |             |                                           |       |                  |         |         |          |
| 5.                          | 24AD435     | Data Exploration and Visualization        | 3/0/2 | 5                | 4       | 40/60   | PC       |
| <b>PRACTICAL</b>            |             |                                           |       |                  |         |         |          |
| 6.                          | 24AD436     | Artificial Intelligence Laboratory        | 0/0/4 | 4                | 2       | 40/60   | PC       |
| 7.                          | 24CS437     | Python Programming Laboratory             | 0/0/4 | 4                | 2       | 40/60   | PC       |
| 8                           | 24CC339     | Data Structures and Algorithms Laboratory | 0/0/4 | 4                | 2       | 40/60   | PC       |

| MANDATORY COURSE |         |                                                                     |         |    |    |     |    |
|------------------|---------|---------------------------------------------------------------------|---------|----|----|-----|----|
| 9.               | 24MC903 | Mandatory Course III<br>Environmental Science<br>and Sustainability | 2/0/0   | 2  | 0  | 0   | MC |
| Total            |         |                                                                     | 17/1/14 | 32 | 23 | 800 |    |

| SEMESTER IV          |             |                                                                 |         |                  |         |         |          |
|----------------------|-------------|-----------------------------------------------------------------|---------|------------------|---------|---------|----------|
| S. No.               | Course Code | Course                                                          | L/T/P   | Contact hrs/week | Credits | Ext/Int | Category |
| THEORY               |             |                                                                 |         |                  |         |         |          |
| 1.                   | 24MA242     | Probability and Statistics                                      | 3/1/0   | 4                | 4       | 60/40   | BS       |
| 2.                   | 24AM442     | Machine Learning                                                | 3/0/0   | 3                | 3       | 60/40   | PC       |
| 3.                   | 24AD443     | Fundamentals of Data Science and Analytics                      | 3/0/0   | 3                | 3       | 60/40   | PC       |
| 4.                   | 24CC344     | Database Design and Management                                  | 3/0/0   | 3                | 3       | 60/40   | ES       |
| 5.                   | 24CS345     | Operating Systems                                               | 3/0/0   | 3                | 3       | 60/40   | ES       |
| THEORY CUM PRACTICAL |             |                                                                 |         |                  |         |         |          |
| 6.                   | 24EC336     | Digital Principles and Computer Organization                    | 3/0/2   | 5                | 4       | 40/60   | ES       |
| PRACTICAL            |             |                                                                 |         |                  |         |         |          |
| 7.                   | 24AM447     | Machine Learning Laboratory                                     | 0/0/4   | 4                | 2       | 40/60   | PC       |
| 8.                   | 24AD448     | Data Science and Analytics Laboratory                           | 0/0/4   | 4                | 2       | 40/60   | PC       |
| 9.                   | 24CC349     | Database Design and Management Laboratory                       | 0/0/4   | 4                | 2       | 40/60   | ES       |
| MANDATORY COURSE     |             |                                                                 |         |                  |         |         |          |
| 9.                   | 24MC904     | Mandatory Course IV<br>Introduction to Women and Gender Studies | 2/0/0   | 2                | 0       | 0       | MC       |
| Total                |             |                                                                 | 20/1/14 | 35               | 26      | 900     |          |

| SEMESTER V |             |        |       |                  |         |         |          |
|------------|-------------|--------|-------|------------------|---------|---------|----------|
| S. No.     | Course Code | Course | L/T/P | Contact hrs/week | Credits | Ext/Int | Category |
| THEORY     |             |        |       |                  |         |         |          |

|                             |         |                             |               |           |           |            |    |
|-----------------------------|---------|-----------------------------|---------------|-----------|-----------|------------|----|
| 1                           | 24CS452 | Theory of Computation       | 3/1/0         | 4         | 4         | 60/40      | PC |
| 2                           | 24AD5XX | Professional Elective I     | 3/0/0         | 3         | 3         | 60/40      | PE |
| 3                           | 24OE6XX | Open Elective I             | 3/0/0         | 3         | 3         | 60/40      | OE |
| <b>THEORY CUM PRACTICAL</b> |         |                             |               |           |           |            |    |
| 4.                          | 24CS456 | Computer Networks           | 3/0/2         | 5         | 4         | 40/60      | PC |
| 5.                          | 24AM455 | Deep Learning for Vision    | 3/0/2         | 5         | 4         | 40/60      | PC |
| 6.                          | 24AD467 | Big Data Analytics          | 3/0/2         | 5         | 4         | 40/60      | PC |
| 7.                          | 24AM457 | Natural Language Processing | 3/0/2         | 5         | 4         | 40/60      | PC |
| <b>Total</b>                |         |                             | <b>21/1/8</b> | <b>30</b> | <b>26</b> | <b>700</b> |    |

| <b>SEMESTER VI</b>          |             |                          |               |                  |           |            |          |
|-----------------------------|-------------|--------------------------|---------------|------------------|-----------|------------|----------|
| S. No.                      | Course Code | Course                   | L/T/P         | Contact hrs/week | Credits   | Ext/Int    | Category |
| <b>THEORY</b>               |             |                          |               |                  |           |            |          |
| 1.                          | 24CS373     | Distributed Computing    | 3/0/0         | 3                | 3         | 60/40      | ES       |
| 2.                          | 24MB151     | Principles of Management | 3/0/0         | 3                | 3         | 60/40      | HS       |
| 3.                          | 24AM5XX     | Professional Elective II | 3/0/0         | 3                | 3         | 60/40      | PE       |
| 4.                          | 24OE6XX     | Open Elective II         | 3/0/0         | 3                | 3         | 60/40      | OE       |
| 5.                          | 24OE6XX     | Open Elective-III        | 3/0/0         | 3                | 3         | 60/40      | OE       |
| <b>THEORY CUM PRACTICAL</b> |             |                          |               |                  |           |            |          |
| 6.                          | 24AD477     | Quantum Computing        | 3/0/2         | 5                | 4         | 40/60      | PC       |
| <b>PRACTICAL</b>            |             |                          |               |                  |           |            |          |
| 7.                          | 24AM861     | Summer Internship        | 0/0/0         | 0                | 2         | 0/100      | IP       |
| <b>Total</b>                |             |                          | <b>18/0/2</b> | <b>20</b>        | <b>21</b> | <b>700</b> |          |

| <b>SEMESTER VII</b> |             |                           |       |                  |         |         |          |
|---------------------|-------------|---------------------------|-------|------------------|---------|---------|----------|
| S. No.              | Course Code | Course                    | L/T/P | Contact hrs/week | Credits | Ext/Int | Category |
| <b>THEORY</b>       |             |                           |       |                  |         |         |          |
|                     | 24HS171     | Human Values and Ethics   | 2/0/0 | 2                | 2       | 60/40   | HS       |
|                     | 24AM5XX     | Professional Elective III | 3/0/0 | 3                | 3       | 60/40   | PE       |

|                             |         |                                          |               |           |           |            |    |
|-----------------------------|---------|------------------------------------------|---------------|-----------|-----------|------------|----|
|                             | 24AM5XX | Professional Elective IV                 | 3/0/0         | 3         | 3         | 60/40      | PE |
|                             | 24AM5XX | Professional Elective V                  | 3/0/0         | 3         | 3         | 60/40      | PE |
|                             | 24OE6XX | Open Elective IV                         | 3/0/0         | 3         | 3         | 60/40      | OE |
| <b>THEORY CUM PRACTICAL</b> |         |                                          |               |           |           |            |    |
| 6.                          | 24CS466 | Object Oriented and Software Engineering | 3/0/2         | 5         | 4         | 40/60      | PC |
| 7.                          | 23EC366 | Embedded System and Internet of Things   | 3/0/2         | 5         | 4         | 40/60      | ES |
| <b>Total</b>                |         |                                          | <b>20/0/4</b> | <b>24</b> | <b>22</b> | <b>700</b> |    |

**SEMESTER VIII**

| S. No.       | Course Code | Course       | L/T/P         | Contact hrs/week | Credits   | Ext/Int    | Category |
|--------------|-------------|--------------|---------------|------------------|-----------|------------|----------|
|              | 24AM781     | Project Work | 0/0/24        | 24               | 12        | 40/60      | PW       |
| <b>Total</b> |             |              | <b>0/0/24</b> | <b>24</b>        | <b>12</b> | <b>100</b> |          |

**PROFESSIONAL ELECTIVE COURSES (15 Credits)**

| Vertical I                       | Vertical II                         | Vertical III                                        | Vertical IV                              | Vertical V               |
|----------------------------------|-------------------------------------|-----------------------------------------------------|------------------------------------------|--------------------------|
| <b>ANALYTICS ENGINEERING</b>     | <b>FULL STACK DEVELOPMENT</b>       | <b>CLOUD COMPUTING AND DATA CENTRE TECHNOLOGIES</b> | <b>EMERGING TECHNOLOGIES</b>             | <b>LANGUAGE MODELING</b> |
| Exploratory Data Analysis        | Web Technology                      | Cloud Computing Essentials                          | Augmented Reality/Virtual Reality        | Knowledge Engineering    |
| Image and Video Analytics        | App Development                     | Cloud Services Management                           | Robotic Process Automation               | Soft Computing           |
| Healthcare Analytics             | Software Testing and Automation     | Virtualization                                      | Cyber Security                           | Cognitive Science        |
| Text and Speech Analysis         | Web Application Security            | Security and Privacy in cloud                       | Cryptocurrency and Blockchain Technology | Ethical Hacking          |
| Business Analytics               | Principles of Programming Languages | Storage technology                                  | Video creation and Editing               | Optimization Technique   |
| Ethics & Artificial Intelligence | Advanced Database                   | Stream Processing                                   | Digital Marketing                        | Recommender Systems      |

**MANDATORY COURSES (Non-Credit)**

| S. No. | Course Code | Course Title                             | Category |
|--------|-------------|------------------------------------------|----------|
| 1.     | 24MC901     | Induction Program                        | MC       |
| 2.     | 24MC902     | Heritage of Tamils                       | MC       |
| 3.     | 24MC903     | Environmental Science and Sustainability | MC       |

|     |         |                                          |    |
|-----|---------|------------------------------------------|----|
| 4 . | 24MC904 | Introduction to Women and Gender Studies | MC |
|-----|---------|------------------------------------------|----|

**OPEN ELECTIVE COURSES (15 Credits)**

| S. No. | Course Code | Course Title                         | L/T/P | Contact Hrs/Wk | Credits |
|--------|-------------|--------------------------------------|-------|----------------|---------|
| 1      | 24OE606     | Fundamentals of Computer Vision      | 3/0/0 | 3              | 3       |
| 2      | 24OE607     | Fundamentals of Machine Learning     | 3/0/0 | 3              | 3       |
| 3      | 24OE608     | Deep Learning Techniques             | 3/0/0 | 3              | 3       |
| 4      | 24OE609     | Natural Language Processing Primer   | 3/0/0 | 3              | 3       |
| 5      | 24OE610     | Neural Networks and its Applications | 3/0/0 | 3              | 3       |

**LIST OF OPEN ELECTIVE COURSES**

| No  | Course Code | Course                                            | L/T/P | Contact Hrs/Wk | Credits |
|-----|-------------|---------------------------------------------------|-------|----------------|---------|
| 1.  | 24OE601     | Text Analytics                                    | 3/0/0 | 3              | 3       |
| 2.  | 24OE602     | Data and Information Security fundamentals        | 3/0/0 | 3              | 3       |
| 3.  | 24OE603     | Health Informatics                                | 3/0/0 | 3              | 3       |
| 4.  | 24OE604     | Management Analytics                              | 3/0/0 | 3              | 3       |
| 5.  | 24OE605     | Data Analytics                                    | 3/0/0 | 3              | 3       |
| 6.  | 24OE606     | Fundamentals of Computer vision                   | 3/0/0 | 3              | 3       |
| 7.  | 24OE607     | Machine Learning and its applications             | 3/0/0 | 3              | 3       |
| 8.  | 24OE608     | Deep Learning Techniques                          | 3/0/0 | 3              | 3       |
| 9.  | 24OE609     | Language Engineering                              | 3/0/0 | 3              | 3       |
| 10. | 24OE610     | Neural Networks                                   | 3/0/0 | 3              | 3       |
| 11. | 24OE611     | Database Fundamentals                             | 3/0/0 | 3              | 3       |
| 12. | 24OE612     | Basics of Image Processing                        | 3/0/0 | 3              | 3       |
| 13. | 24OE613     | Agile Methodology                                 | 3/0/0 | 3              | 3       |
| 14. | 24OE614     | Web Technology Fundamentals                       | 3/0/0 | 3              | 3       |
| 15. | 24OE615     | App development Fundamentals                      | 3/0/0 | 3              | 3       |
| 16. | 24OE616     | Introduction to Augmented Reality/Virtual Reality | 3/0/0 | 3              | 3       |
| 17. | 24OE617     | Software Engineering                              | 3/0/0 | 3              | 3       |
| 18. | 24OE618     | Foundation of Cloud Computing                     | 3/0/0 | 3              | 3       |
| 19. | 24OE619     | Java Programming                                  | 3/0/0 | 3              | 3       |
| 20. | 24OE620     | Block Chain Technology                            | 3/0/0 | 3              | 3       |
| 21. | 24OE621     | Introduction to VLSI design                       | 3/0/0 | 3              | 3       |
| 22. | 24OE622     | Communication Engineering                         | 3/0/0 | 3              | 3       |
| 23. | 24OE623     | Sensors and Actuators                             | 3/0/0 | 3              | 3       |
| 24. | 24OE624     | Embedded System                                   | 3/0/0 | 3              | 3       |
| 25. | 24OE625     | Introduction to Internet of Things                | 3/0/0 | 3              | 3       |

|     |         |                                            |       |   |   |
|-----|---------|--------------------------------------------|-------|---|---|
| 26. | 24OE626 | Industrial Automation with PLC and SCADA   | 3/0/0 | 3 | 3 |
| 27. | 24OE627 | Electric Vehicle Technology                | 3/0/0 | 3 | 3 |
| 28. | 24OE628 | Energy Technology                          | 3/0/0 | 3 | 3 |
| 29. | 24OE629 | Battery Management Systems                 | 3/0/0 | 3 | 3 |
| 30. | 24OE630 | Power Converters for Electrical Appliances | 3/0/0 | 3 | 3 |
| 31. | 24OE631 | Foundation of Robotics                     | 3/0/0 | 3 | 3 |
| 32. | 24OE632 | Drone Technologies                         | 3/0/0 | 3 | 3 |
| 33. | 24OE633 | Industrial Management                      | 3/0/0 | 3 | 3 |
| 34. | 24OE634 | Additive Manufacturing                     | 3/0/0 | 3 | 3 |
| 35. | 24OE635 | Introduction to Non Destructive Testing    | 3/0/0 | 3 | 3 |

**HUMANITIES SCIENCES (11 Credits)**

| S. No. | Course Code | Course Title             | L/T/P | Contact Hrs/Wk | Credits |
|--------|-------------|--------------------------|-------|----------------|---------|
| 1.     | 24HS114     | Technical English        | 2/0/2 | 4              | 3       |
| 2.     | 24HS124     | Professional English     | 2/0/2 | 4              | 3       |
| 3.     | 24MB151     | Principles of Management | 3/0/0 | 3              | 3       |
| 4.     | 24HS171     | Human Values and Ethics  | 2/0/0 | 2              | 2       |

**BASIC SCIENCES (24 Credits)**

| S.No. | Course Code | Course Title                                 | L/T/P | Contact Hrs/Wk | Credits |
|-------|-------------|----------------------------------------------|-------|----------------|---------|
| 1     | 24MA211     | Matrices and Calculus                        | 3/1/0 | 4              | 4       |
| 2     | 24AC213     | Chemistry for Computing Sciences             | 3/0/2 | 5              | 4       |
| 3     | 24MA221     | Differential Equations and Complex Functions | 3/1/0 | 4              | 4       |
| 4     | 24AP225     | Physics for Computing Sciences               | 3/0/2 | 5              | 4       |
| 5     | 24MA231     | Discrete Mathematics                         | 3/1/0 | 4              | 4       |
| 6     | 24MA242     | Probability and Statistics                   | 3/1/0 | 4              | 4       |

**ENGINEERING SCIENCES (34 Credits)**

| S. No. | Course Code | Course Title                                 | L/T/P | Contact Hrs/Wk | Credits |
|--------|-------------|----------------------------------------------|-------|----------------|---------|
| 1.     | 24CS312     | Programming in C                             | 3/0/0 | 3              | 3       |
| 2.     | 24EG315     | Engineering Graphics                         | 1/0/4 | 5              | 3       |
| 3.     | 24CS316     | Programming in C Laboratory                  | 0/0/4 | 4              | 2       |
| 4.     | 24EE312     | Basic Electrical and Electronics Engineering | 3/0/0 | 3              | 3       |
| 5.     | 24CS423     | Object Oriented Programming and Java         | 3/0/0 | 3              | 3       |
| 6.     | 24EP315     | Engineering Practices Laboratory             | 0/0/4 | 4              | 2       |

|     |         |                                                 |       |   |   |
|-----|---------|-------------------------------------------------|-------|---|---|
| 7.  | 24CS427 | Object Oriented Programming and Java Laboratory | 0/0/4 | 4 | 2 |
| 8.  | 24CC334 | Database Design and Management                  | 3/0/0 | 3 | 3 |
| 9.  | 24CC337 | Database Design and Management Laboratory       | 0/0/4 | 4 | 2 |
| 10. | 24EC336 | Digital Principles and Computer Organization    | 3/0/2 | 5 | 4 |
| 11. | 24CS373 | Distributed Computing                           | 3/0/0 | 3 | 3 |
| 12. | 23EC366 | Embedded Systems and Internet of Things         | 3/0/2 | 5 | 4 |

**PROGRAM CORE (60 Credits)**

| S. No. | Course Code | Course Title                               | L/T/P | Contact Hrs/Wk | Credits |
|--------|-------------|--------------------------------------------|-------|----------------|---------|
| 1.     | 24AD432     | Artificial Intelligence I                  | 3/0/0 | 3              | 3       |
| 2.     | 24CS433     | Python Programming                         | 3/0/0 | 3              | 3       |
| 3.     | 24CC336     | Data Structures and Algorithms             | 3/0/0 | 3              | 3       |
| 4.     | 24AD435     | Data Exploration and Visualization         | 3/0/2 | 5              | 4       |
| 5.     | 24AD436     | Artificial Intelligence I Laboratory       | 0/0/4 | 4              | 2       |
| 6.     | 24CS437     | Python Programming Laboratory              | 0/0/4 | 4              | 2       |
| 7.     | 24CS339     | Data Structures and Algorithms Laboratory  | 0/0/4 | 4              | 2       |
| 8.     | 24AM442     | Machine Learning                           | 3/0/0 | 3              | 3       |
| 9.     | 24AD443     | Fundamentals of Data Science and Analytics | 3/0/0 | 3              | 3       |
| 10.    | 24AM447     | Machine Learning Laboratory                | 0/0/4 | 4              | 2       |
| 11.    | 24AD448     | Data Science and Analytics Laboratory      | 0/0/4 | 4              | 2       |
| 12.    | 24CS452     | Theory of Computation                      | 3/1/0 | 4              | 4       |
| 13.    | 24CS456     | Computer Networks                          | 3/0/2 | 5              | 4       |
| 14.    | 24AM455     | Deep Learning for Vision                   | 3/0/2 | 5              | 4       |
| 15.    | 24AD467     | Big Data Analytics                         | 3/0/2 | 5              | 4       |
| 16.    | 24AM457     | Natural Language Processing                | 3/0/2 | 5              | 4       |
| 17.    | 24AD461     | Artificial Intelligence II                 | 3/0/0 | 3              | 3       |
| 18.    | 24AD477     | Quantum Computing                          | 3/0/2 | 5              | 4       |
| 19.    | 24CS466     | Software Engineering methodologies         | 3/0/2 | 5              | 4       |

**PROFESSIONAL ELECTIVE COURSES (15 Credits)**

| S. No.                                                            | Course Code | Course Title                             | L/T/P | Contact Hrs/Wk | Credits |
|-------------------------------------------------------------------|-------------|------------------------------------------|-------|----------------|---------|
| <b>VERTICAL I: ANALYTICS ENGINEERING</b>                          |             |                                          |       |                |         |
| 1                                                                 | 24AD501     | Exploratory Data Analysis                | 3/0/0 | 3              | 3       |
| 2                                                                 | 24AD502     | Image and Video Analytics                | 3/0/0 | 3              | 3       |
| 3                                                                 | 24AD503     | Healthcare Analytics                     | 3/0/0 | 3              | 3       |
| 4                                                                 | 24AD504     | Text and Speech Analysis                 | 3/0/0 | 3              | 3       |
| 5                                                                 | 24AD505     | Business Analytics                       | 3/0/0 | 3              | 3       |
| 6                                                                 | 24AD506     | Ethics and Artificial Intelligence       | 3/0/0 | 3              | 3       |
| <b>VERTICAL II: FULL STACK DEVELOPMENT</b>                        |             |                                          |       |                |         |
| 7                                                                 | 24CC501     | Web Technology                           | 3/0/0 | 3              | 3       |
| 8                                                                 | 24CC502     | App Development                          | 3/0/0 | 3              | 3       |
| 9                                                                 | 24CC503     | Software Testing and Automation          | 3/0/0 | 3              | 3       |
| 10                                                                | 24CC504     | Web Application Security                 | 3/0/0 | 3              | 3       |
| 11                                                                | 24CC505     | Principles of Programming Languages      | 3/0/0 | 3              | 3       |
| 12                                                                | 24CC506     | Advanced Databases                       | 3/0/0 | 3              | 3       |
| <b>VERTICAL III: CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES</b> |             |                                          |       |                |         |
| 13                                                                | 24CS501     | Cloud Computing Essentials               | 3/0/0 | 3              | 3       |
| 14                                                                | 24CS502     | Cloud Services Management                | 3/0/0 | 3              | 3       |
| 15                                                                | 24CS503     | Virtualization                           | 3/0/0 | 3              | 3       |
| 16                                                                | 24CS504     | Security and Privacy in Cloud            | 3/0/0 | 3              | 3       |
| 17                                                                | 24CS505     | Storage Technology                       | 3/0/0 | 3              | 3       |
| 18                                                                | 24CS506     | Stream Processing                        | 3/0/0 | 3              | 3       |
| <b>VERTICAL IV: EMERGING TECHNOLOGIES</b>                         |             |                                          |       |                |         |
| 19                                                                | 24AD508     | Augmented Reality/Virtual Reality        | 3/0/0 | 3              | 3       |
| 20                                                                | 24AD509     | Robotic Process Automation               | 3/0/0 | 3              | 3       |
| 21                                                                | 24AD510     | Cyber Security                           | 3/0/0 | 3              | 3       |
| 22                                                                | 24AM501     | Cryptocurrency and Blockchain Technology | 3/0/0 | 3              | 3       |
| 23                                                                | 24AM502     | Video Creation and Editing               | 3/0/0 | 3              | 3       |
| 24                                                                | 24AM503     | Digital Marketing                        | 3/0/0 | 3              | 3       |
| <b>VERTICAL V: LANGUAGE MODELING</b>                              |             |                                          |       |                |         |
| 25                                                                | 24AM512     | Knowledge Engineering                    | 3/0/0 | 3              | 3       |
| 26                                                                | 24AM507     | Soft Computing                           | 3/0/0 | 3              | 3       |
| 27                                                                | 24AM508     | Cognitive Science                        | 3/0/0 | 3              | 3       |
| 28                                                                | 24AM509     | Ethical Hacking                          | 3/0/0 | 3              | 3       |
| 29                                                                | 24AM510     | Optimization Techniques                  | 3/0/0 | 3              | 3       |

|    |         |                     |       |   |   |
|----|---------|---------------------|-------|---|---|
| 30 | 24AM511 | Recommender Systems | 3/0/0 | 3 | 3 |
|----|---------|---------------------|-------|---|---|

#### INDUSTRYPRACTICES(2Credits)

| S. No | Course Code | CourseTitle | L/T/P | Contact Hrs/Wk | Credits |
|-------|-------------|-------------|-------|----------------|---------|
| 1.    | 24AM861     | Internship  | 0/0/0 | -              | 2       |

#### PROJECTWORK(12Credits)

| S. No | Course Code | CourseTitle | L/T/P  | Contact Hrs/Wk | Credits |
|-------|-------------|-------------|--------|----------------|---------|
| 1.    | 24AM781     | ProjectWork | 0/0/24 | 24             | 12      |

# **SYLLABUS OF FIFTH SEMESTER**

## REGULATIONS 2024

## B. E. COMPUTER SCIENCE AND ENGINEERING (AIML)

## SYLLABI FOR SEMESTERS V to VIII

## PROFESSIONAL CORE – V SEM

| Course Code                                                                                                                                                                                                                                                                                                                                      | CourseName                                                                                                             | Category              | Hours/Week               |   |   | C        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|---|----------|
|                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                        |                       | L                        | T | P |          |
| 24CS452                                                                                                                                                                                                                                                                                                                                          | THEORYOFCOMPUTATION                                                                                                    | PC                    | 3                        | 1 | 0 | 4        |
| Regulation                                                                                                                                                                                                                                                                                                                                       | NatureoftheCourse                                                                                                      | Semester              | DataBook/Codes/Standards |   |   |          |
| R-2024                                                                                                                                                                                                                                                                                                                                           | Theory                                                                                                                 | V                     | -                        |   |   |          |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                           |                                                                                                                        | Co-requisiteCourse(s) |                          |   |   |          |
| DiscreteMathematics                                                                                                                                                                                                                                                                                                                              |                                                                                                                        | -                     |                          |   |   |          |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                 |                                                                                                                        |                       |                          |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                | Tounderstandthematematicalfoundationsofcomputation                                                                     |                       |                          |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                | Tomodelcomputationalproblemsusingautomataandformallanguages                                                            |                       |                          |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                                | Todesigngrammarsandmachinesforlanguage recognition                                                                     |                       |                          |   |   |          |
| 4                                                                                                                                                                                                                                                                                                                                                | Toanalyzecomputationalproblemsfordecidabilityandcomplexity                                                             |                       |                          |   |   |          |
| 5                                                                                                                                                                                                                                                                                                                                                | TostudyNP-completeandintractableproblems                                                                               |                       |                          |   |   |          |
| CourseOutcomes:Uponcompletionofthecourse,studentswillbeable to                                                                                                                                                                                                                                                                                   |                                                                                                                        |                       |                          |   |   |          |
| C452.1                                                                                                                                                                                                                                                                                                                                           | Applytheprinciplesoffiniteautomatatoconstructandvalidateautomatamodelsforgiven regularlanguages.                       |                       |                          |   |   | [AP]     |
| C452.2                                                                                                                                                                                                                                                                                                                                           | Analyze regularlanguagesbyderivingequivalent regularexpressions,automata,and verifying language properties.            |                       |                          |   |   | [AN]     |
| C452.3                                                                                                                                                                                                                                                                                                                                           | Designandanalyzecontextfreegrammarsandpushdownautomatatomodeland recognize syntactic language constructs.              |                       |                          |   |   | [AN]     |
| C452.4                                                                                                                                                                                                                                                                                                                                           | ApplyTuringmachineconceptstodesigncomputationalmodelsandevaluatelanguage acceptanceandfunctioncomputation.             |                       |                          |   |   | [AP]     |
| C452.5                                                                                                                                                                                                                                                                                                                                           | Analyzecomputationalproblemstodeterminedecidability,undecidability,andclassify themundercomplexityclassessuchasPandNP. |                       |                          |   |   | [AP]     |
| CourseContents                                                                                                                                                                                                                                                                                                                                   |                                                                                                                        |                       |                          |   |   |          |
| Unit-1                                                                                                                                                                                                                                                                                                                                           | MATHEMATICALFOUNDATIONSANDFINITEAUTOMATA                                                                               |                       |                          |   |   | C01 9Hrs |
| Need for automata theory – Sets, relations, functions, strings and languages – Introduction to formal proofs – Directproof–Proofbycontradiction–Induction–FiniteAutomata(FA)–DeterministicFiniteAutomata(DFA)– Non-deterministic Finite Automata (NFA) – ε-NFA – Equivalence of DFA, NFA and ε-NFA – Conversion of NFA to DFA–MinimizationofDFA. |                                                                                                                        |                       |                          |   |   |          |
| Unit-2                                                                                                                                                                                                                                                                                                                                           | REGULAREXPRESSIONSANDREGULARLANGUAGES                                                                                  |                       |                          |   |   | C02 9Hrs |
| Regularexpressions–Regularlanguages–Equivalenceoffiniteautomataandregularexpressions–Arden's theorem–Closurepropertiesofregularlanguages–Pumpinglemmaforregularlanguages –Decisionproperties ofregularlanguages–Applicationsofregularlanguages.                                                                                                  |                                                                                                                        |                       |                          |   |   |          |
| Unit-3                                                                                                                                                                                                                                                                                                                                           | CONTEXTFREEGRAMMARANDPUSHDOWNAUTOMATA                                                                                  |                       |                          |   |   | C03 9Hrs |

|                                                                                                                                                                                                                                                                                                                                                                                                       |                                                    |            |              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|------------|--------------|
| Chomsky hierarchy of languages – Context Free Grammar (CFG) – Derivations and parse trees – Ambiguity in grammars and languages – Push Down Automata (PDA): Definition and moves – Instantaneous descriptions – Acceptance by final state and empty stack – Languages of PDA – Equivalence of PDA and CFG – Deterministic Push Down Automata (DPDA).                                                  |                                                    |            |              |
| <b>Unit-4</b>                                                                                                                                                                                                                                                                                                                                                                                         | <b>PROPERTIES OF CFL AND TURING MACHINES</b>       | <b>C04</b> | <b>9Hrs</b>  |
| Simplification of CFG – Normal forms for CFG – Chomsky Normal Form (CNF) – Greibach Normal Form (GNF) – Pumping lemma for CFL – Closure properties of CFL – Turing Machine (TM): Basic model, definition and representation – Instantaneous description – Language acceptance by TM – Variants of Turing Machines – Programming techniques for Turing machines – TM as a computer of functions.       |                                                    |            |              |
| <b>Unit-5</b>                                                                                                                                                                                                                                                                                                                                                                                         | <b>UNDECIDABILITY AND COMPUTATIONAL COMPLEXITY</b> | <b>C05</b> | <b>9Hrs</b>  |
| Recursive and recursively enumerable languages – Decidable and undecidable problems – Undecidable problems related to Turing Machines – Post Correspondence Problem (PCP) and Modified PCP – Universal Turing Machine – Time and space complexity – Complexity classes P and NP – NP-complete problems – Polynomial time reductions – SAT and 3-CNF SAT – Overview of classical NP-complete problems. |                                                    |            |              |
| <b>Total Hours</b>                                                                                                                                                                                                                                                                                                                                                                                    |                                                    |            | <b>45Hrs</b> |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                                                                                                                                                     |                                                    |            |              |

|                         |                                                                                                                                                                                                           |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                       | Introduction to Automata Theory, Languages, and Computation John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, 3rd Edition, Pearson Education, 2006.                                                    |
| 2                       | Introduction to Languages and the Theory of Computation John C. Martin, 4th Edition, McGraw-Hill Education (India), 2010.                                                                                 |
| <b>Reference Books:</b> |                                                                                                                                                                                                           |
| 1                       | An Introduction to Formal Languages and Automata Peter Linz, 6th Edition, Jones & Bartlett Learning, 2016.                                                                                                |
| 2                       | Theory of Computer Science Automata Languages and Computation K. L. P. Mishra and N. Chandrasekaran, 3rd Edition, PHI Learning Pvt. Ltd., 2012.                                                           |
| 3                       | Introduction to the Theory of Computation Michael Sipser, 3rd Edition, Cengage Learning, 2013.                                                                                                            |
| <b>Web References:</b>  |                                                                                                                                                                                                           |
| 1                       | <a href="https://www.geeksforgeeks.org/theory-of-computation/theory-of-computation-automata-tutorials/">https://www.geeksforgeeks.org/theory-of-computation/theory-of-computation-automata-tutorials/</a> |
| 2                       | <a href="https://archive.nptel.ac.in/courses">https://archive.nptel.ac.in/courses</a> .                                                                                                                   |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      |            |            |                          |
| Understand                                                  | 20                    |                | 20                   |            |            |                          |
| Apply                                                       | 80                    | 100            | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C452.1      | 3    | 3    | 1    | 1    | 2    | -    | -    | -    | -    | -     | 1     | 2     | 1     |
| C452.2      | 3    | 3    | 2    | 1    | 2    | -    | -    | -    | -    | -     | 2     | 2     | 2     |
| C452.3      | 3    | 3    | 2    | 2    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 2     |
| C452.4      | 3    | 3    | 2    | 2    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 2     |
| C452.5      | 3    | 3    | 1    | 2    | 1    | -    | -    | -    | -    | -     | 3     | 2     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

Prepared by

Approved by

| Course Code                                                                                                                                                                                                                                                                                                                                                                                             | Course Name                                                                                                                            | Category               | Hours/Week                |   |   | C     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|-------|
|                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                        |                        | L                         | T | P |       |
| 24AD510                                                                                                                                                                                                                                                                                                                                                                                                 | CYBER SECURITY                                                                                                                         | PE                     | 3                         | 0 | 0 | 3     |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                              | Nature of the Course                                                                                                                   | Semester               | Data Book/Codes/Standards |   |   |       |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                    | THEORY                                                                                                                                 |                        | -                         |   |   |       |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                        | Co-requisite Course(s) |                           |   |   |       |
| Computer Network, Network Security                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                        | -                      |                           |   |   |       |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                        |                        |                           |   |   |       |
| 1                                                                                                                                                                                                                                                                                                                                                                                                       | To understand the fundamental concepts of cyber security, security goals, threat landscape and cyber laws including the Indian IT Act. |                        |                           |   |   |       |
| 2                                                                                                                                                                                                                                                                                                                                                                                                       | To analyze various cyber threats, malware types, social engineering techniques and web/network attacks.                                |                        |                           |   |   |       |
| 3                                                                                                                                                                                                                                                                                                                                                                                                       | To perform reconnaissance, scanning and vulnerability assessment using standard security tools.                                        |                        |                           |   |   |       |
| 4                                                                                                                                                                                                                                                                                                                                                                                                       | To understand intrusion detection systems, monitoring techniques and security event management concepts.                               |                        |                           |   |   |       |
| 5                                                                                                                                                                                                                                                                                                                                                                                                       | To configure and implement firewall technologies and intrusion prevention mechanisms in controlled environments.                       |                        |                           |   |   |       |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                        |                        |                           |   |   |       |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                        |                        |                           |   |   |       |
| C510.1                                                                                                                                                                                                                                                                                                                                                                                                  | Explain the fundamental principles of cyber security, security goals and cyber laws.                                                   |                        |                           |   |   | U     |
| C510.2                                                                                                                                                                                                                                                                                                                                                                                                  | Examine various cyber threats, vulnerabilities and attack mechanisms in computing systems.                                             |                        |                           |   |   | AP    |
| C510.3                                                                                                                                                                                                                                                                                                                                                                                                  | Apply various tools to perform information gathering.                                                                                  |                        |                           |   |   | AP    |
| C510.4                                                                                                                                                                                                                                                                                                                                                                                                  | Use intrusion techniques to detect intrusion                                                                                           |                        |                           |   |   | AP    |
| C510.5                                                                                                                                                                                                                                                                                                                                                                                                  | Demonstrate intrusion prevention techniques to prevent intrusion                                                                       |                        |                           |   |   | AP    |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                        |                        |                           |   |   |       |
| Unit – 1                                                                                                                                                                                                                                                                                                                                                                                                | UNIT I – FOUNDATIONS OF CYBER SECURITY                                                                                                 |                        |                           |   |   | C01 9 |
| Introduction to Cyber Security – Evolution of Internet and its Impact – Security Goals (Confidentiality, Integrity, Availability) – Need for Cyber Security – Threat Landscape – Cyber Crime: History and Classification – Cybercriminals and Motivations – Global Perspective on Cyber Crimes – Cyber Laws – The Indian IT Act –Data Privacy Act- Cybercrime Investigation and Punishment.             |                                                                                                                                        |                        |                           |   |   |       |
| Unit – 2                                                                                                                                                                                                                                                                                                                                                                                                | CYBER THREATS AND DEFENSE MECHANISMS                                                                                                   |                        |                           |   |   | C02 9 |
| Overview of OWASP – Security Breaches and Case Studies – Threats and Vulnerabilities – Types of Malicious Attacks – Malware (Virus, Worm, Trojan, Ransomware, Spyware) –Social Engineering Techniques – Data poisoning Attacks-adversarial attacks-Wireless Network Attacks – Web Application Attacks – Common Attack Vectors –Attack Tools and Basic Countermeasures – Security of AI Systems.         |                                                                                                                                        |                        |                           |   |   |       |
| Unit – 3                                                                                                                                                                                                                                                                                                                                                                                                | RECONNAISSANCE AND VULNERABILITY SCANNING                                                                                              |                        |                           |   |   | C03 9 |
| Foot printing and Information Gathering – Harvester – Whois – Netcraft – Host – DNS Information Extraction – Email Server Information Extraction – Scanning Concepts – Port Scanning and Network Scanning – Vulnerability Scanning – Scanning Methodology – Ping Sweep Techniques – Nmap Command Switches – SYN, Stealth, XMAS, NULL, IDLE, FIN Scans – Banner Grabbing – OS Fingerprinting Techniques. |                                                                                                                                        |                        |                           |   |   |       |
| Unit – 4                                                                                                                                                                                                                                                                                                                                                                                                | INTRUSION DETECTION AND SECURITY MONITORING                                                                                            |                        |                           |   |   | C04 9 |

|                                                                                                                                                                                                                                                                              |                                                                                                                 |  |       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|--|-------|
| Host-Based Intrusion Detection Systems – Network-Based Intrusion Detection Systems – Distributed and Hybrid IDS – Intrusion Detection Exchange Format – Honeypots – Snort Architecture and Configuration – Basic Security Event Monitoring Concepts                          |                                                                                                                 |  |       |
| Unit – 5                                                                                                                                                                                                                                                                     | INTRUSION PREVENTION AND FIREWALL TECHNOLOGIES                                                                  |  | C05 9 |
| Firewalls and Intrusion Prevention Systems – Need for Firewalls – Firewall Characteristics – Access Control Policies – Types of Firewalls – Firewall Placement and Configurations – Next Generation Firewalls-Intrusion Prevention Systems – Unified Threat Management (UTM) |                                                                                                                 |  |       |
| Total Hours                                                                                                                                                                                                                                                                  |                                                                                                                 |  | 45    |
| Textbooks:                                                                                                                                                                                                                                                                   |                                                                                                                 |  |       |
| 1                                                                                                                                                                                                                                                                            | Anand Shinde, <i>Introduction to Cyber Security: Guide to the World of Cyber Security</i> , Notion Press, 2021. |  |       |
| 2                                                                                                                                                                                                                                                                            | Nina Godbole and Sunit Belapure, <i>Cyber Security</i> , Wiley India.                                           |  |       |
| 3                                                                                                                                                                                                                                                                            | Charles P. Pfleeger & Shari Lawrence Pfleeger, <i>Security in Computing</i> , Pearson                           |  |       |
| Reference Books:                                                                                                                                                                                                                                                             |                                                                                                                 |  |       |
| 1                                                                                                                                                                                                                                                                            | William Stallings, <i>Cryptography and Network Security</i> , Pearson.                                          |  |       |
| 2                                                                                                                                                                                                                                                                            | Michael E. Whitman & Herbert J. Mattord, <i>Principles of Information Security</i> , Cengage.                   |  |       |
| 3                                                                                                                                                                                                                                                                            | Ric Messier, <i>CEH v11 Study Guide</i> , Wiley.                                                                |  |       |
| 4                                                                                                                                                                                                                                                                            | The Information Technology Act, 2000 (Amended 2008), Government of India                                        |  |       |
| Web References:                                                                                                                                                                                                                                                              |                                                                                                                 |  |       |
| 1                                                                                                                                                                                                                                                                            | <a href="https://owasp.org/www-project-top-ten/">https://owasp.org/www-project-top-ten/</a>                     |  |       |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 80                    |                | 20                   |            |            |                          |
| Apply                                                       | 20                    | 100            | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| C0s/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PS0 1 | PS0 2 | PS0 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C510.1      | 3    | 2    | 1    | 1    | -    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 2     |
| C510.2      | 2    | 3    | 2    | 2    | -    | -    | -    | -    | -    | -     | 1     | 3     | 2     | 1     |
| C510.3      | 2    | 3    | 2    | 3    | -    | -    | -    | -    | -    | -     | 1     | 3     | 2     | 2     |
| C510.4      | 2    | 3    | 2    | 3    | -    | -    | -    | -    | -    | -     | 1     | 3     | 2     | 2     |
| C510.5      | 2    | 2    | 3    | 2    | -    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 1     |

1 - low, 2 - medium, 3 - high, '-' - no correlation

Prepared by

Approved by

| Course Code                                                                                                                                                                                     | CourseName                                                                            | Category              | Hours/Week               |   |     | C    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-----------------------|--------------------------|---|-----|------|
|                                                                                                                                                                                                 |                                                                                       |                       | L                        | T | P   |      |
| 24CS456                                                                                                                                                                                         | COMPUTERNETWORKS                                                                      | PC                    | 3                        | 0 | 2   | 4    |
| Regulation                                                                                                                                                                                      | NatureoftheCourse                                                                     | Semester              | DataBook/Codes/Standards |   |     |      |
| R24                                                                                                                                                                                             | THEORYCUMPRACTICAL                                                                    | IV                    | -                        |   |     |      |
| Pre-requisiteCourse(s)                                                                                                                                                                          |                                                                                       | Co-requisiteCourse(s) |                          |   |     |      |
| -                                                                                                                                                                                               |                                                                                       | PYTHONPROGRAMMING     |                          |   |     |      |
| CourseObjectives                                                                                                                                                                                |                                                                                       |                       |                          |   |     |      |
| 1                                                                                                                                                                                               | Tounderstandtheconceptoflayeringinnetworks.                                           |                       |                          |   |     |      |
| 2                                                                                                                                                                                               | ToapplytheTCP/IPprotocolsuitetoimplementthe functions.                                |                       |                          |   |     |      |
| 3                                                                                                                                                                                               | Toimplementtheend-to-endflowofinformation.                                            |                       |                          |   |     |      |
| 4                                                                                                                                                                                               | Toanalyzethefunctionsofnetworklayerandthevariousroutingprotocols.                     |                       |                          |   |     |      |
| 5                                                                                                                                                                                               | ToanalyzethefunctionsandprotocolsoftheTransportlayer.                                 |                       |                          |   |     |      |
| CourseOutcomes                                                                                                                                                                                  |                                                                                       |                       |                          |   |     |      |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                  |                                                                                       |                       |                          |   |     |      |
| C456.1                                                                                                                                                                                          | Understandthebasiclayersofcomputernetworksanditsfunctions.                            |                       |                          |   |     | [U]  |
| C456.2                                                                                                                                                                                          | ApplyTCP/UDPprotocolstoimplementthedataflowfromonenodetoanotherin the TransportLayer. |                       |                          |   |     | [AP] |
| C456.3                                                                                                                                                                                          | Applyvariousinternetprotocolstoimplementvariousfunctionsinthenetwork.                 |                       |                          |   |     | [AP] |
| C456.4                                                                                                                                                                                          | Analyzevariousroutingalgorithms.                                                      |                       |                          |   |     | [AN] |
| C456.5                                                                                                                                                                                          | Analyzetheworkingprinciplesofvariousapplicationlayerprotocols.                        |                       |                          |   |     | [AN] |
| CourseContents                                                                                                                                                                                  |                                                                                       |                       |                          |   |     |      |
| Unit-1                                                                                                                                                                                          | IntroductionAndApplicationLayer                                                       |                       |                          |   | C01 | 9    |
| DataCommunication-Networks-NetworkTypes-ProtocolLayering-TCP/IPProtocolsuite-OSIModel-IntroductiontoSockets-ApplicationLayerprotocols:HTTP-FTP-Emailprotocols(SMTP-POP3-IMAP-MIME) - DNS - SNMP |                                                                                       |                       |                          |   |     |      |
| PRACTICAL:                                                                                                                                                                                      |                                                                                       |                       |                          |   |     |      |
| 1. Learntousecommandssliketcpdump,netstat,ifconfig,nslookupandtraceroute.Capturepingandtraceroute PDUs using a network protocol analyzer and examine.                                           |                                                                                       |                       |                          |   |     |      |
| 2. WriteaHTTPwebclientprogramtodownloadawebsiteusingTCPsockets.                                                                                                                                 |                                                                                       |                       |                          |   |     |      |
| 3. ApplicationsusingTCPsocketslike:a)Echoclientandechoserverb)Chat                                                                                                                              |                                                                                       |                       |                          |   |     |      |
| Unit-2                                                                                                                                                                                          | TransportLayer                                                                        |                       |                          |   | C02 | 9    |
| Introduction -Transport-LayerProtocols: UDP-TCP: Connection Management-Flowcontrol-CongestionControl -Congestionavoidance(DECbit,RED)-SCTP-QualityofService                                     |                                                                                       |                       |                          |   |     |      |
| PRACTICAL:                                                                                                                                                                                      |                                                                                       |                       |                          |   |     |      |
| 4. SimulationofDNSusingUDPsockets.                                                                                                                                                              |                                                                                       |                       |                          |   |     |      |
| 5. StudyofTCP/UDPperformanceusingSimulationtool.                                                                                                                                                |                                                                                       |                       |                          |   |     |      |
| 6. StudyofNetworksimulator(NS)andSimulationofCongestionControlAlgorithmsusingNS.                                                                                                                |                                                                                       |                       |                          |   |     |      |
| Unit-3                                                                                                                                                                                          | NetworkLayer                                                                          |                       |                          |   | C03 | 9    |
| Switching:PacketSwitching -Internetprotocol-IPV4-IPAddressing-Subnetting-IPV6,ARP,RARP,ICMP, DHCP                                                                                               |                                                                                       |                       |                          |   |     |      |
| PRACTICAL:                                                                                                                                                                                      |                                                                                       |                       |                          |   |     |      |
| 7. UseatoollikeWiresharktocapturepacketsandexaminethepackets.                                                                                                                                   |                                                                                       |                       |                          |   |     |      |
| 8. WriteacodesimulatingARP/RARPprotocols.                                                                                                                                                       |                                                                                       |                       |                          |   |     |      |
| Unit-4                                                                                                                                                                                          | Routing                                                                               |                       |                          |   | C04 | 9    |

|                                                                                                                                                                                                                                                                             |                                                                                                                                 |     |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-----|----|
| Routing and protocols: Unicast routing - Distance Vector Routing - RIP - Link State Routing - OSPF - Path-vector routing - BGP - Multicast Routing: DVMRP - PIM.                                                                                                            |                                                                                                                                 |     |    |
| <b>PRACTICAL:</b>                                                                                                                                                                                                                                                           |                                                                                                                                 |     |    |
| 9.SimulationofDistanceVector/LinkStateRoutingalgorithm.                                                                                                                                                                                                                     |                                                                                                                                 |     |    |
| Unit-5                                                                                                                                                                                                                                                                      | DataLinkAndPhysicalLayers                                                                                                       | C05 | 9  |
| DataLinkLayer-Framing-Flowcontrol-Errorcontrol-Data-LinkLayerProtocols-HDLC-PPP-MediaAccess Control - Ethernet Basics - CSMA/CD - Virtual LAN - Wireless LAN (802.11) - Physical Layer: Data and Signals - Performance - Transmission media- Switching - Circuit Switching. |                                                                                                                                 |     |    |
| <b>PRACTICAL:</b>                                                                                                                                                                                                                                                           |                                                                                                                                 |     |    |
| 10.Simulationofanerrorcorrectioncode(likeCRC).                                                                                                                                                                                                                              |                                                                                                                                 |     |    |
| TotalHours                                                                                                                                                                                                                                                                  |                                                                                                                                 |     | 45 |
| Practical                                                                                                                                                                                                                                                                   |                                                                                                                                 |     | 30 |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                           |                                                                                                                                 |     |    |
| 1                                                                                                                                                                                                                                                                           | JamesF.Kurose,KeithW.Ross,ComputerNetworking,ATop-DownApproachFeaturingtheInternet, Eighth Edition, Pearson Education, 2021.    |     |    |
| 2                                                                                                                                                                                                                                                                           | BehrouzA.Forouzan,DataCommunicationsandNetworkingwithTCP/IPProtocolSuite,Sixth Edition TMH, 2022                                |     |    |
| <b>ReferenceBooks:</b>                                                                                                                                                                                                                                                      |                                                                                                                                 |     |    |
| 1                                                                                                                                                                                                                                                                           | Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012. |     |    |
| 2                                                                                                                                                                                                                                                                           | WilliamStallings,DataandComputerCommunications,TenthEdition,PearsonEducation,2013                                               |     |    |
| 3                                                                                                                                                                                                                                                                           | NaderF.Mir,ComputerandCommunicationNetworks,SecondEdition,PrenticeHall,2014.                                                    |     |    |
| 4                                                                                                                                                                                                                                                                           | Ying-DarLin,Ren-HungHwang,FredBaker,“ComputerNetworks:AnOpenSourceApproach”, McGraw Hill, 2012.                                 |     |    |
| <b>WebReferences:</b>                                                                                                                                                                                                                                                       |                                                                                                                                 |     |    |
| 1                                                                                                                                                                                                                                                                           | <a href="https://onlinecourses.nptel.ac.in/noc22_cs19/preview">https://onlinecourses.nptel.ac.in/noc22_cs19/preview</a> .       |     |    |

| BLOOM'S TAXONOMY LEVEL   | ASSESSMENT-1 |          |          | ASSESSMENT-2    |                | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|--------------------------|--------------|----------|----------|-----------------|----------------|------------|------------|--------------------------|
|                          | CIA1         | CIA2     | MODEL    | LAB EXPERIMENTS | MODEL LAB EXAM |            |            |                          |
|                          | 6            | 6        | 8        | 10              | 10             |            |            |                          |
| Remember                 |              |          |          |                 |                |            | 100%       | 100%                     |
| Understand               | 80%          |          | 20%      | 20%             | 20%            | 20%        |            |                          |
| Apply                    | 20%          | 80%      | 40%      | 40%             | 40%            | 40%        |            |                          |
| Analyze                  |              | 20%      | 40%      | 40%             | 40%            | 40%        |            |                          |
| Evaluate                 |              |          |          |                 |                |            |            |                          |
| Create                   |              |          |          |                 |                |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>     | <b>6</b> | <b>8</b> | <b>10</b>       | <b>10</b>      | <b>10</b>  | <b>10</b>  | <b>40</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 marks.
- Experiment wise laboratory completion 10 marks and Model lab exam will be conducted for 100 marks and the same will be converted to 10 marks.
- BTL marks split up may vary based on the nature of the subject.

| C0s/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| CO456.1     | 3    | 3    | 3    | 3    | 2    | -    | -    | -    | -    | -     | -     | 2     | 2     | 2     |

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO456.2 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 | 2 | 3 |
| CO456.3 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 2 | 2 | 2 |
| CO456.4 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 | 2 | 2 |
| CO456.5 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 | 2 | 3 |

1-low, 2-medium, 3-high, '-'-no correlation

Prepared by

Approved by

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Course Name                                                                                                                                                                                              | Category               | Hours/Week                |   |   | C   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                          |                        | L                         | T | P |     |
| 24OE632                                                                                                                                                                                                                                                                                                                                                                                                                                                        | BASICS OF DRONE TECHNOLOGY                                                                                                                                                                               | PC                     | 3                         | 0 | 0 | 3   |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Nature of the Course                                                                                                                                                                                     | Semester               | Data Book/Codes/Standards |   |   |     |
| R24                                                                                                                                                                                                                                                                                                                                                                                                                                                            | THEORY                                                                                                                                                                                                   |                        | -----                     |   |   |     |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                          | Co-requisite Course(s) |                           |   |   |     |
| Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                          | Nil                    |                           |   |   |     |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                          |                        |                           |   |   |     |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                              | To understand the basics of drone concepts                                                                                                                                                               |                        |                           |   |   |     |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                              | To learn and understand the fundamentals of design, fabrication and programming of drone                                                                                                                 |                        |                           |   |   |     |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                              | To impart the knowledge of an flying and operation of drone                                                                                                                                              |                        |                           |   |   |     |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                              | To know about the various applications of drone                                                                                                                                                          |                        |                           |   |   |     |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                              | To understand the safety risks and guidelines of fly safely                                                                                                                                              |                        |                           |   |   |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                          |                        |                           |   |   |     |
| Upon completion of the course, student shall have ability to                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                          |                        |                           |   |   |     |
| C101.1                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Know about a various type of drone technology, drone fabrication and programming.                                                                                                                        |                        |                           |   |   | [U] |
| C101.2                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Execute the suitable operating procedures for functioning a drone                                                                                                                                        |                        |                           |   |   | [U] |
| C101.3                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Select appropriate sensors and actuators for Drones                                                                                                                                                      |                        |                           |   |   | [U] |
| C101.4                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Develop a drone mechanism for specific applications                                                                                                                                                      |                        |                           |   |   | [U] |
| C101.5                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Create the programs for various drones                                                                                                                                                                   |                        |                           |   |   | [U] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                          |                        |                           |   |   |     |
| Unit – 1                                                                                                                                                                                                                                                                                                                                                                                                                                                       | INTRODUCTION TO DRONE TECHNOLOGY                                                                                                                                                                         |                        |                           |   |   | 9   |
| Drone Concept - Terminology- History of drone - Overview of the main drone parts- Function of the component parts -Technical characteristics of the Types of current generation of drones based on their method of propulsion- Operation of drone. Classifications of the UAV.                                                                                                                                                                                 |                                                                                                                                                                                                          |                        |                           |   |   |     |
| Unit – 2                                                                                                                                                                                                                                                                                                                                                                                                                                                       | DRONE DESIGN, FABRICATION AND PROGRAMMING                                                                                                                                                                |                        |                           |   |   | 9   |
| Assembling a drone - The energy sources- Types of autonomy - Drones configurations - methods of programming – programing, compiling and uploading - data collection - Wi-Fi connection.                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                          |                        |                           |   |   |     |
| Unit – 3                                                                                                                                                                                                                                                                                                                                                                                                                                                       | DRONE OPERATION                                                                                                                                                                                          |                        |                           |   |   | 9   |
| Flight modes- Operation in a controlled environment- Drone controls- Multi rotor stabilization –management tools: Sensors, Onboard storage, control system-Removable storage devices – Linked devices and applications.                                                                                                                                                                                                                                        |                                                                                                                                                                                                          |                        |                           |   |   |     |
| Unit – 4                                                                                                                                                                                                                                                                                                                                                                                                                                                       | DRONE COMMERCIAL APPLICATIONS                                                                                                                                                                            |                        |                           |   |   | 9   |
| Selection of a drone based on the application - Drones in the insurance sector- Drones in delivering parcels and other cargo - Drones in agriculture - Drones in inspection of transmission lines and power distribution - Drones in filming and panoramic picturing. Drones in military applications. Drone technology impact on the businesses- Drone business through entrepreneurship - Opportunities/applications for entrepreneurship and employability. |                                                                                                                                                                                                          |                        |                           |   |   |     |
| Unit – 5                                                                                                                                                                                                                                                                                                                                                                                                                                                       | FUTURE DRONES AND SAFETY                                                                                                                                                                                 |                        |                           |   |   | 9   |
| The safety risks- Guidelines to fly safely - Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms.                                                                                                                                                                                                                                                           |                                                                                                                                                                                                          |                        |                           |   |   |     |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                          |                        |                           |   |   |     |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, 2021 John Wiley & Sons, Inc. |                        |                           |   |   |     |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Terry Kilby and Belinda Kilby, “Make: Getting Started with Drones “, Maker Media, Inc, 2016 .                                                                                                            |                        |                           |   |   |     |
| Reference Books:                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                          |                        |                           |   |   |     |

|                        |                                                                                                                               |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 1                      | John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016.                |
| 2                      | Zavrnsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018. |
| <b>Web References:</b> |                                                                                                                               |
| 1                      | <a href="https://dronelaunchacademy.com/">https://dronelaunchacademy.com/</a>                                                 |
| 2                      | <a href="https://www.airsight.com/knowledge-hub/drone-basics">https://www.airsight.com/knowledge-hub/drone-basics</a>         |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                                                    |                       |                   |                         | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand                                                  | 2                     | 2                 | 2                       |            |            |                          |
| Apply                                                       | 4                     | 4                 | 6                       |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|
| C101.1      | √    | √    |      |      |      | √    | √    | √    |      |       |       | √     |       |       |       |
| C101.2      | √    | √    | √    | √    |      |      |      |      |      |       |       | √     |       |       |       |
| C101.3      | √    | √    |      |      |      | √    | √    | √    |      |       |       | √     |       |       |       |
| C101.4      | √    | √    | √    | √    |      |      |      |      |      |       |       | √     |       |       |       |
| C101.5      | √    | √    | √    | √    | √    | √    |      |      |      |       |       | √     |       |       |       |

Prepared by

Approved by



| Course Code                                                                                                                                                                                                                                                                                                                                                | Course Name                                                                                         | Category               | Hours/Week                |   |     | C    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-----|------|
|                                                                                                                                                                                                                                                                                                                                                            |                                                                                                     |                        | L                         | T | P   |      |
| 24CS456                                                                                                                                                                                                                                                                                                                                                    | COMPUTER NETWORKS                                                                                   | PC                     | 3                         | 0 | 2   | 4    |
| Regulation                                                                                                                                                                                                                                                                                                                                                 | Nature of the Course                                                                                | Semester               | Data Book/Codes/Standards |   |     |      |
| R24                                                                                                                                                                                                                                                                                                                                                        | THEORY CUM PRACTICAL                                                                                | IV                     | -                         |   |     |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                    |                                                                                                     | Co-requisite Course(s) |                           |   |     |      |
| -                                                                                                                                                                                                                                                                                                                                                          |                                                                                                     | PYTHON PROGRAMMING     |                           |   |     |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                          |                                                                                                     |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                          | To understand the concept of layering in networks.                                                  |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                          | To apply the TCP/IP protocol suite to implement the functions.                                      |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                                                          | To implement the end-to-end flow of information.                                                    |                        |                           |   |     |      |
| 4                                                                                                                                                                                                                                                                                                                                                          | To analyze the functions of network layer and the various routing protocols.                        |                        |                           |   |     |      |
| 5                                                                                                                                                                                                                                                                                                                                                          | To analyze the functions and protocols of the Transport layer.                                      |                        |                           |   |     |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                            |                                                                                                     |                        |                           |   |     |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                    |                                                                                                     |                        |                           |   |     |      |
| C456.1                                                                                                                                                                                                                                                                                                                                                     | Understand the basic layers of computer networks and its functions.                                 |                        |                           |   |     | [U]  |
| C456.2                                                                                                                                                                                                                                                                                                                                                     | Apply TCP/UDP protocols to implement the data flow from one node to another in the Transport Layer. |                        |                           |   |     | [AP] |
| C456.3                                                                                                                                                                                                                                                                                                                                                     | Apply various internet protocols to implement various functions in the network.                     |                        |                           |   |     | [AP] |
| C456.4                                                                                                                                                                                                                                                                                                                                                     | Analyze various routing algorithms.                                                                 |                        |                           |   |     | [AN] |
| C456.5                                                                                                                                                                                                                                                                                                                                                     | Analyze the working principles of various application layer protocols.                              |                        |                           |   |     | [AN] |
| Course Contents                                                                                                                                                                                                                                                                                                                                            |                                                                                                     |                        |                           |   |     |      |
| Unit – 1                                                                                                                                                                                                                                                                                                                                                   | Introduction And Application Layer                                                                  |                        |                           |   | C01 | 9    |
| Data Communication - Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Introduction to Sockets – Application Layer protocols: HTTP – FTP – Email protocols (SMTP – POP3 – IMAP – MIME) – DNS – SNMP                                                                                                                       |                                                                                                     |                        |                           |   |     |      |
| <b>PRACTICAL:</b><br>1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine.<br>2. Write a HTTP web client program to download a web page using TCP sockets.<br>3. Applications using TCP sockets like: a) Echo client and echo server b) Chat |                                                                                                     |                        |                           |   |     |      |
| Unit – 2                                                                                                                                                                                                                                                                                                                                                   | Transport Layer                                                                                     |                        |                           |   | C02 | 9    |
| Introduction – Transport-Layer Protocols: UDP – TCP: Connection Management – Flow control – Congestion Control – Congestion avoidance (DECbit, RED) – SCTP – Quality of Service                                                                                                                                                                            |                                                                                                     |                        |                           |   |     |      |
| <b>PRACTICAL:</b><br>4. Simulation of DNS using UDP sockets.<br>5. Study of TCP/UDP performance using Simulation tool.<br>6. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS                                                                                                                                      |                                                                                                     |                        |                           |   |     |      |
| Unit – 3                                                                                                                                                                                                                                                                                                                                                   | Network Layer                                                                                       |                        |                           |   | C03 | 9    |
| Switching : Packet Switching – Internet protocol – IPV4 – IP Addressing – Subnetting – IPV6, ARP, RARP, ICMP, DHCP                                                                                                                                                                                                                                         |                                                                                                     |                        |                           |   |     |      |
| <b>PRACTICAL:</b><br>7. Use a tool like Wireshark to capture packets and examine the packets.<br>8. Write a code simulating ARP / RARP protocols.                                                                                                                                                                                                          |                                                                                                     |                        |                           |   |     |      |
| Unit – 4                                                                                                                                                                                                                                                                                                                                                   | Routing                                                                                             |                        |                           |   | C04 | 9    |
| Routing and protocols: Unicast routing – Distance Vector Routing – RIP – Link State Routing – OSPF – Path-vector routing – BGP – Multicast Routing: DVMRP – PIM.                                                                                                                                                                                           |                                                                                                     |                        |                           |   |     |      |

|                                                                                                                                                                                                                                                                                                  |                                                                                                                                           |            |           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|
| <b>PRACTICAL:</b><br>9. Simulation of Distance Vector/ Link State Routing algorithm.                                                                                                                                                                                                             |                                                                                                                                           |            |           |
| <b>Unit – 5</b>                                                                                                                                                                                                                                                                                  | <b>Data Link And Physical Layers</b>                                                                                                      | <b>C05</b> | <b>9</b>  |
| Data Link Layer – Framing – Flow control – Error control – Data-Link Layer Protocols – HDLC – PPP – Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) – Physical Layer: Data and Signals – Performance – Transmission media- Switching – Circuit Switching. |                                                                                                                                           |            |           |
| <b>PRACTICAL:</b><br>10. Simulation of an error correction code (like CRC)                                                                                                                                                                                                                       |                                                                                                                                           |            |           |
| <b>Total Hours</b>                                                                                                                                                                                                                                                                               |                                                                                                                                           |            | <b>45</b> |
| <b>Practical</b>                                                                                                                                                                                                                                                                                 |                                                                                                                                           |            | <b>30</b> |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                                                |                                                                                                                                           |            |           |
| 1                                                                                                                                                                                                                                                                                                | James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021. |            |           |
| 2                                                                                                                                                                                                                                                                                                | Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022                               |            |           |
| <b>Reference Books:</b>                                                                                                                                                                                                                                                                          |                                                                                                                                           |            |           |
| 1                                                                                                                                                                                                                                                                                                | Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.           |            |           |
| 2                                                                                                                                                                                                                                                                                                | William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013                                               |            |           |
| 3                                                                                                                                                                                                                                                                                                | Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.                                                   |            |           |
| 4                                                                                                                                                                                                                                                                                                | Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill, 2012.                                |            |           |
| <b>Web References:</b>                                                                                                                                                                                                                                                                           |                                                                                                                                           |            |           |
| 1                                                                                                                                                                                                                                                                                                | <a href="https://onlinecourses.nptel.ac.in/noc22_cs19/preview">https://onlinecourses.nptel.ac.in/noc22_cs19/preview</a> .                 |            |           |

| BLOOM'S TAXONOMY LEVEL  | ASSESSMENT-1 |          |          | ASSESSMENT-2    |                | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|-------------------------|--------------|----------|----------|-----------------|----------------|------------|------------|--------------------------|
|                         | CIA1         | CIA2     | MODEL    | LAB EXPERIMENTS | MODEL LAB EXAM |            |            |                          |
|                         | 6            | 6        | 8        | 10              | 10             |            |            |                          |
| Remember                |              |          |          |                 |                |            | 100%       | 100%                     |
| Understand              | 80%          |          | 20%      | 20%             | 20%            | 20%        |            |                          |
| Apply                   | 20%          | 80%      | 40%      | 40%             | 40%            | 40%        |            |                          |
| Analyze                 |              | 20%      | 40%      | 40%             | 40%            | 40%        |            |                          |
| Evaluate                |              |          |          |                 |                |            |            |                          |
| Create                  |              |          |          |                 |                |            |            |                          |
| <b>Total (100Marks)</b> | <b>6</b>     | <b>6</b> | <b>8</b> | <b>10</b>       | <b>10</b>      | <b>10</b>  | <b>10</b>  | <b>40</b>                |

| COs/ POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|------|-------|-------|-------|-------|-------|
| CO456.1  | 3   | 3   | 3   | 3   | 2   | -   | -   | -   | -    | -     | -     | 2     | 2     | 2     |
| CO456.2  | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | -    | -     | -     | 3     | 2     | 3     |
| CO456.3  | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | -    | -     | -     | 2     | 2     | 2     |

|         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C0456.4 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 | 2 | 2 |
| C0456.5 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 3 | 2 | 3 |

1 - low, 2 - medium, 3 - high, '-' - no correlation

Prepared by

Approved by

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                     | CourseName                                                                                                         | Category              | Hours/Week               |   |   | C    |   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|---|------|---|
|                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                    |                       | L                        | T | P |      |   |
| 24AD467                                                                                                                                                                                                                                                                                                                                                                                                                         | BIG DATA ANALYTICS                                                                                                 | PC                    | 3                        | 0 | 2 | 4    |   |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                      | NatureoftheCourse                                                                                                  | Semester              | DataBook/Codes/Standards |   |   |      |   |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                            | THEORY CUM PRACTICAL                                                                                               | V                     | -                        |   |   |      |   |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                    | Co-requisiteCourse(s) |                          |   |   |      |   |
| -                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                    | -                     |                          |   |   |      |   |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                    |                       |                          |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                               | Understand Big Data concepts, 5V's, technologies, and applications.                                                |                       |                          |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                               | Explain NoSQL, distribution models, and Cassandra for scalable data management.                                    |                       |                          |   |   |      |   |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                               | Apply data preprocessing and MapReduce for large-scale data processing.                                            |                       |                          |   |   |      |   |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                               | Use Hadoop ecosystem and HiveQL for scaledata analysis.                                                            |                       |                          |   |   |      |   |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                               | Apply MongoDB and ApacheSpark for efficient big data storage and processing.                                       |                       |                          |   |   |      |   |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                    |                       |                          |   |   |      |   |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                    |                       |                          |   |   |      |   |
| C467.1                                                                                                                                                                                                                                                                                                                                                                                                                          | Explain Big Data characteristics, tools, and applications.                                                         |                       |                          |   |   | [U]  |   |
| C467.2                                                                                                                                                                                                                                                                                                                                                                                                                          | Describe NoSQL databases and distributed data models.                                                              |                       |                          |   |   | [U]  |   |
| C467.3                                                                                                                                                                                                                                                                                                                                                                                                                          | Apply preprocessing techniques and execute MapReduce programs                                                      |                       |                          |   |   | [AP] |   |
| C467.4                                                                                                                                                                                                                                                                                                                                                                                                                          | Use Hadoop framework, HiveQL, and related components for big data processing.                                      |                       |                          |   |   | [AP] |   |
| C467.5                                                                                                                                                                                                                                                                                                                                                                                                                          | Apply MongoDB database operations and ApacheSpark concepts for efficientstorage, querying, andprocessingofbigdata. |                       |                          |   |   | [AP] |   |
| CourseContents                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                    |                       |                          |   |   |      |   |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                          | FundamentalsofBigData                                                                                              |                       |                          |   |   | C01  | 9 |
| Introduction to Big Data -Definition-Characteristics ofBig Data (Volume, Variety, Velocity, Veracity, Value), Convergenceofkeytrends , Domain-specificexamplesofbigdata, webanalytics,Toolsandtechnologiesfor big data analytics, Big Data applications- Big Data technologies - introduction to Hadoop - opensource technologies - cloud and Big Data - mobile business intelligence - Crowd sourcing analytics- Big DataStack |                                                                                                                    |                       |                          |   |   |      |   |
| PRACTICAL:                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                    |                       |                          |   |   |      |   |
| 1. Downloading and installing Hadoop; UnderstandingdifferentHadoop modes.Startupscripts,Configuration files.                                                                                                                                                                                                                                                                                                                    |                                                                                                                    |                       |                          |   |   |      |   |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                          | NoSQLDatabasesandCassandraArchitecture                                                                             |                       |                          |   |   | C02  | 9 |
| IntroductiontoNoSQL,Typesof NoSQLDatabases(Document,Column,Graph,Key-Value),andpopular NoSQLdatabases,schemalessdatabases,distributionmodels-master-slavereplication-consistency- Cassandra - Cassandra data model - Cassandra clients.                                                                                                                                                                                         |                                                                                                                    |                       |                          |   |   |      |   |
| PRACTICAL:                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                    |                       |                          |   |   |      |   |
| 2. Hadoop Implementation offilemanagementtasks,suchasAddingfilesanddirectories,retrievingfiles and Deleting files.                                                                                                                                                                                                                                                                                                              |                                                                                                                    |                       |                          |   |   |      |   |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                          | DataPreprocessingandMapReduceApplications                                                                          |                       |                          |   |   | C03  | 9 |
| Data Preprocessing: Data cleaning,transformation,andintegrationtechniquesinBigData.MapReduce workflows- anatomyofMapReducejobrun - classicMapReduce-YARN -failuresinclassicMap-reduce andYARN - jobscheduling -shuffleandsort- taskexecution -MapReducetypes-inputformats-output formats.                                                                                                                                       |                                                                                                                    |                       |                          |   |   |      |   |

**PRACTICAL:**

3. Implementation of Matrix Multiplication with Hadoop MapReduce.
4. Run a basic Word Count MapReduce program to understand MapReduce Paradigm.
5. Develop a MapReduce program to find the maximum temperature in each year.
6. Develop a MapReduce to find the maximum electrical consumption in each year given electrical consumption for each month in each year.
7. Develop a MapReduce to analyze weather dataset and print whether the day is shiny or cool day.

|               |                                     |            |          |
|---------------|-------------------------------------|------------|----------|
| <b>Unit-4</b> | Basics of Hadoop and Hive Framework | <b>C04</b> | <b>9</b> |
|---------------|-------------------------------------|------------|----------|

|                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                      |            |           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|
| Dataformat –analyzingdata with Hadoop –scalingout–designof Hadoopdistributedfilesystem(HDFS)<br>– HDFSconcepts–dataflow–Hadoopl/O–dataintegrity–compression–serialization–Hive–datatypes<br>andfileformats–Avro–file–baseddatastructures–HiveQLdatadefinition–HiveQLdatamanipulation–<br>HiveQL queries. |                                                                                                                                                                                      |            |           |
| <b>PRACTICAL:</b>                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                      |            |           |
| 8. InstallationofHivealongwithpracticeexamples.                                                                                                                                                                                                                                                          |                                                                                                                                                                                      |            |           |
| <b>Unit–5</b>                                                                                                                                                                                                                                                                                            | Modern Big Data Frameworks and Tools                                                                                                                                                 | <b>C05</b> | <b>9</b>  |
| Introduction – Features – Data types – Mongo DB Query language – CRUD operations – Arrays –<br>Functions: Count – Sort – Limit – Skip – Aggregate – Map Reduce.Indexes–Mongo Import – Mongo<br>Export–Introduction toSpark,Spark Architecture and its components, Features of Spark,Spark vs<br>Hadoop.  |                                                                                                                                                                                      |            |           |
| <b>PRACTICAL:</b>                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                      |            |           |
| 9. Implement NoSQL Database Operations: CRUD operations, Arrays using MongoDB.                                                                                                                                                                                                                           |                                                                                                                                                                                      |            |           |
| 10.Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB.                                                                                                                                                                                                                           |                                                                                                                                                                                      |            |           |
| <b>TotalHours</b>                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                      |            | <b>45</b> |
| <b>Practica</b>                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                      |            | <b>30</b> |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                      |            |           |
| 1                                                                                                                                                                                                                                                                                                        | Ramesh Sharda, Dursun<br>DelenandEfraimTurban,BusinessIntelligence,Analytics,DataScience, and AI, 5th Edition,<br>Pearson,2025.                                                      |            |           |
| 2                                                                                                                                                                                                                                                                                                        | Rathinaraja Jeyaraj,Ganesh Kumar Pugalendhi, Anand Paul, "Big Data with Hadoop Map<br>Reduce A Classroom Approach", Apple Academic Press, CRC Press, Taylor & Francis<br>Group,2021. |            |           |
| 3                                                                                                                                                                                                                                                                                                        | GaneshChadra Deka,"Nosql: database forStorage<br>andRetrievalofDatainCloud",CRCPress,2017.                                                                                           |            |           |
| 4                                                                                                                                                                                                                                                                                                        | Fru Nde, "The Ultimate Guide to Programming Apache Hive", NextGen Publishing, 2015.                                                                                                  |            |           |
| 5                                                                                                                                                                                                                                                                                                        | Lars George,"HBase: The Definitive Guide", O'Reilley, 2nd Edition (2017)                                                                                                             |            |           |
| 6                                                                                                                                                                                                                                                                                                        | Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2nd Edition(2022)                                                                                                         |            |           |
| 7                                                                                                                                                                                                                                                                                                        | HoldenKarau,AndyKonwinski,PatrickWendellandMateiZaharia, <i>LearningSpark:Lightning-<br/>FastBigDataAnalysis</i> , 2nd Edition, O'Reilly Media, 2020.                                |            |           |
| <b>ReferenceBooks:</b>                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                      |            |           |
| 1                                                                                                                                                                                                                                                                                                        | Seema Acharya,Subhashini Chellappan, "Big Data and Analytics", 2nd Edition, Wiley,<br>2019.                                                                                          |            |           |
| 2                                                                                                                                                                                                                                                                                                        | Nathan Marz and James Warren, Big Data: Principles and Best Practices of<br>Scalable Real-Time DataSystems,1st Edition, Manning Publications, 2023.                                  |            |           |
| 3                                                                                                                                                                                                                                                                                                        | Joe Reis and Matt Housley, <i>FundamentalsofDataEngineering</i> , O'Reilly Media, 2022.                                                                                              |            |           |
| <b>WebReferences:</b>                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                      |            |           |
| 1                                                                                                                                                                                                                                                                                                        | <a href="https://onlinecourses.nptel.ac.in/noc26_cs09/preview">https://onlinecourses.nptel.ac.in/noc26_cs09/preview</a>                                                              |            |           |
| 2                                                                                                                                                                                                                                                                                                        | <a href="https://onlinecourses.nptel.ac.in/noc25_cs131/preview">https://onlinecourses.nptel.ac.in/noc25_cs131/preview</a>                                                            |            |           |

| BLOOM'S TAXONOMY LEVEL   | ASSESSMENT-1 |          |          | ASSESSMENT-2    |                | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|--------------------------|--------------|----------|----------|-----------------|----------------|------------|------------|--------------------------|
|                          | CIA1         | CIA2     | MODEL    | LAB EXPERIMENTS | MODEL LAB EXAM |            |            |                          |
|                          | 6            | 6        | 8        | 10              | 10             |            |            |                          |
| Remember                 |              |          |          | 10              | 10             | 10         | 10         | 40                       |
| Understand               | 70           | 70       | 30       |                 |                |            |            |                          |
| Apply                    | 30           | 30       | 70       |                 |                |            |            |                          |
| Analyze                  |              |          |          |                 |                |            |            |                          |
| Evaluate                 |              |          |          |                 |                |            |            |                          |
| Create                   |              |          |          |                 |                |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>     | <b>6</b> | <b>8</b> | <b>10</b>       | <b>10</b>      | <b>10</b>  | <b>10</b>  | <b>40</b>                |



- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 marks.
- Experiment wise laboratory completion 10 marks and Model lab exam will be conducted for 100 marks and the same will be converted to 10 marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PS<br>02 | PSO<br>3 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|
| C467.1      | 3       | 2       | 1       | -       | 2       | 1       | 1       | -       | 1       | -        | 2        | 2        | 2        | 1        |
| C467.2      | 3       | 2       | 2       | 1       | 2       | -       | -       | -       | 1       | -        | 2        | 2        | 3        | 2        |
| C467.3      | 3       | 2       | 3       | 2       | 3       | -       | -       | 1       | 1       | 1        | 2        | 2        | 3        | 3        |
| C467.4      | 3       | 2       | 3       | 2       | 3       | 1       | -       | 1       | 1       | 1        | 2        | 2        | 3        | 3        |
| C467.5      | 3       | 2       | 3       | 2       | 3       | 1       | -       | 1       | 1       | 1        | 2        | 3        | 3        | 3        |

1-low, 2-medium, 3-high, 6-'-no correlation

Prepared by  
Approved by



| Course Code                                                                                                                                                                                                                                                                                                                                                                                                           | Course Name                                                                 | Category               | Hours/Week                |   |     | C    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------|---------------------------|---|-----|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                             |                        | L                         | T | P   |      |
| 24AM455                                                                                                                                                                                                                                                                                                                                                                                                               | Deep learning for Vision                                                    | PC                     | 3                         | 0 | 2   | 4    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                            | Nature of the Course                                                        | Semester               | Data Book/Codes/Standards |   |     |      |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                  | THEORY CUM PRACTICAL                                                        | V                      | -                         |   |     |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                               |                                                                             | Co-requisite Course(s) |                           |   |     |      |
| Probability and Statistics, Machine Learning                                                                                                                                                                                                                                                                                                                                                                          |                                                                             | Neural Networks        |                           |   |     |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                             |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                     | To introduce basic computer vision concepts                                 |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                     | To understand the methods and terminologies involved in deep neural network |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                     | To impart knowledge on CNN                                                  |                        |                           |   |     |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                     | To introduce RNN and Deep Generative model                                  |                        |                           |   |     |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                     | To solve real world computer vision applications using Deep learning        |                        |                           |   |     |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                             |                        |                           |   |     |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                                               |                                                                             |                        |                           |   |     |      |
| C455.1                                                                                                                                                                                                                                                                                                                                                                                                                | Implement basic Image processing operations                                 |                        |                           |   |     | [AP] |
| C455.2                                                                                                                                                                                                                                                                                                                                                                                                                | Understand the basic concept of deep learning                               |                        |                           |   |     | [U]  |
| C455.3                                                                                                                                                                                                                                                                                                                                                                                                                | Design and implement CNN and RNN and Deep generative model                  |                        |                           |   |     | [AP] |
| C455.4                                                                                                                                                                                                                                                                                                                                                                                                                | Understand the role of deep learning in computer vision applications.       |                        |                           |   |     | [AP] |
| C455.5                                                                                                                                                                                                                                                                                                                                                                                                                | Design and implement Deep generative model                                  |                        |                           |   |     | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                             |                        |                           |   |     |      |
| Unit – 1                                                                                                                                                                                                                                                                                                                                                                                                              | COMPUTER VISION BASICS                                                      |                        |                           |   | C01 | 9+6  |
| Introduction to Image Formation, Capture and Representation; Linear Filtering, Correlation, Convolution Visual Features and Representations: Edge, Blobs, Corner Detection; Visual Features extraction: Bag-of-words, VLAD; RANSAC, Hough transform - Applications of Computer Vision.                                                                                                                                |                                                                             |                        |                           |   |     |      |
| <b>PRACTICAL:</b><br>1. Implementation of basic Image processing operations including Feature Representation and Feature Extraction<br>2. Implement a neural network model to classify different types of fruits (e.g., apple, banana, orange) using given input features such as color, size, and texture.<br>3. To implement Bag-of-Words Model for Image Classification                                            |                                                                             |                        |                           |   |     |      |
| Unit – 2                                                                                                                                                                                                                                                                                                                                                                                                              | INTRODUCTION TO DEEP LEARNING                                               |                        |                           |   | C02 | 9+6  |
| Deep Feed-Forward Neural Networks – Gradient Descent – Back-Propagation and Other Differentiation Algorithms – Vanishing Gradient Problem – Mitigation – Rectified Linear Unit (ReLU) – Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization for Deep Learning – Dropout – Adversarial Training – Optimization for Training Deep Models. |                                                                             |                        |                           |   |     |      |
| <b>PRACTICAL:</b><br>1. To implement a deep neural network model for Images by using ResNet-50 or VGG16<br>2. To implement program (Python using TensorFlow/Keras) that demonstrates the Vanishing Gradient Problem<br>3. To implement a neural network for image classification and apply regularization techniques to prevent overfitting.                                                                          |                                                                             |                        |                           |   |     |      |
| Unit – 3                                                                                                                                                                                                                                                                                                                                                                                                              | VISUALIZATION AND UNDERSTANDING CNN                                         |                        |                           |   | C03 | 9+6  |

**Convolutional Neural Networks (CNNs):** Introduction to CNNs; Evolution of CNN Architectures: AlexNet, ZFNet, ResNet, VGG. Visualization of Kernels; Backprop-to-image/ Deconvolution Methods; Deep Dream, Hallucination, Neural Style Transfer; CAM, Grad-CAM. Semantic Segmentation: Introduction to Semantic Segmentation, Fully Convolutional Networks (FCN), Popular Semantic Segmentation Architectures (U-Net, SegNet, DeepLab, etc.)

**PRACTICAL:**

1. To implement CNN for Image classification using AlexNet or ResNet-50
2. To implement deep Learning Program Backprop-to-Image (Saliency Map)
3. To implement SegNet for Image Segmentation

|                 |                                                   |            |            |
|-----------------|---------------------------------------------------|------------|------------|
| <b>Unit – 4</b> | <b>CNN and RNN FOR IMAGE AND VIDEO PROCESSING</b> | <b>C04</b> | <b>9+6</b> |
|-----------------|---------------------------------------------------|------------|------------|

**CNNs for Recognition, Verification, Detection, Segmentation:** CNNs for Recognition and Verification (Siamese Networks, Triplet Loss, Contrastive Loss, Ranking Loss); CNNs for Detection: Background of Object Detection, Popular Object Detection Architectures (RCNN, Fast RCNN, Faster RCNN, YOLO, etc.), Training Object Detection Models and Fine-tuning Pretrained Models – CNNs for Segmentation: FCN, SegNet – Recurrent Neural Networks (RNNs): Review of RNNs; CNN + RNN Models for Video Understanding: Spatio-temporal Models, Action/Activity Recognition–

**PRACTICAL:**

1. To implement CNN for Image segmentation using U-Net or Mask R-CNN.
2. To implement RNN for video processing using Long Short-Term Memory or Gated Recurrent Unit
3. To implement CNN (for spatial features)

|                 |                               |            |            |
|-----------------|-------------------------------|------------|------------|
| <b>Unit – 5</b> | <b>DEEP GENERATIVE MODELS</b> | <b>C05</b> | <b>9+6</b> |
|-----------------|-------------------------------|------------|------------|

**Deep Generative Models:** Review of (Popular) Deep Generative Models: GANs, VAEs Variants and Applications of Generative Models in Vision: Applications: Image Editing, Inpainting, Superresolution, 3D Object Generation, Security; Recent Trends: Self-supervised Learning; Reinforcement Learning in Vision; Introduction to GNN, Recent Advances and Future Directions in Deep Learning for Computer Vision.

**PRACTICAL:**

1. Implementation of Deep Generative model for Image editing using StyleGAN.
2. Build a deep learning model that converts a low-resolution image into a high-resolution image.
3. Implement a simple deep learning program implementing a GNN model for node classification.

|                              |           |
|------------------------------|-----------|
| <b>Total Theory Hours</b>    | <b>45</b> |
| <b>Total Practical Hours</b> | <b>30</b> |

**Textbooks:**

|          |                                                                                                                                    |
|----------|------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b> | Deep Learning for Vision Systems by <a href="#">Mohamed Elgendy</a> , 1 <sup>st</sup> edition, Manning, 2020.                      |
| <b>2</b> | Computer Vision Using Deep Learning: Neural Network Architectures with Python and Keras, Vaibhav Verdhani Limerick, Ireland, 2021. |

**Reference Books:**

|          |                                                                                                        |
|----------|--------------------------------------------------------------------------------------------------------|
| <b>1</b> | Rajalingappaa Shanmugamani, Deep Learning for Computer Vision, Packt Publishing, 2018                  |
| <b>2</b> | Modern Computer Vision with PyTorch, V. Kishore Ayyadevara, Yeshwanth Reddy, 2020 Packt Publishing Ltd |

**Web References:**

|          |                                                                                   |
|----------|-----------------------------------------------------------------------------------|
| <b>1</b> | <a href="https://nptel.ac.in/">https://nptel.ac.in/</a>                           |
| <b>2</b> | <a href="https://www.deeplearningbook.org/">https://www.deeplearningbook.org/</a> |

|  |                     |                     |                   |                   |                     |
|--|---------------------|---------------------|-------------------|-------------------|---------------------|
|  | <b>ASSESSMENT-1</b> | <b>ASSESSMENT-2</b> | <b>ASSIGNMENT</b> | <b>ATTENDANCE</b> | <b>END SEMESTER</b> |
|--|---------------------|---------------------|-------------------|-------------------|---------------------|

|                  | CIA 1 | CIA2  | MODEL | LAB EXPERIMENTS | MODEL LAB EXAM |    |    |    |
|------------------|-------|-------|-------|-----------------|----------------|----|----|----|
|                  | 6     | 6     | 8     | 10              | 10             | 10 | 10 | 40 |
| Remember         |       |       |       | 10              | 10             | 10 | 10 | 40 |
| Understand       | 40 %  |       | 20%   |                 |                |    |    |    |
| Apply            | 60 %  | 100 % | 80%   |                 |                |    |    |    |
| Analyze          |       |       |       |                 |                |    |    |    |
| Evaluate         |       |       |       |                 |                |    |    |    |
| Create           |       |       |       |                 |                |    |    |    |
| Total (100Marks) | 6     | 6     | 8     | 10              | 10             | 10 | 10 | 40 |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 marks.
- Experiment wise laboratory completion 10 marks and Model lab exam will be conducted for 100 marks and the same will be converted to 10 marks.
- BTL mark split up may vary based on the nature of the subject.

| C0s/<br>POs | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P010 | P011 | PS01 | PS02 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C455.1      | 3   | 3   | 2   | 3   | 3   | -   | -   | --  | -   | 2    | 2    | -    | 2    |
| C455.2      | 3   | 2   | 2   | 2   | 2   | -   | -   | -   | -   | 2    | 2    | -    | 2    |
| C455.3      | 3   | 3   | 2   | 3   | 3   | -   | -   | -   | -   | 2    | 2    | -    | 3    |
| C455.4      | 3   | 2   | 3   | 2   | 2   | -   | -   | -   | -   | 2    | 2    | -    | 3    |
| C455.5      | 3   | 3   | 2   | 3   | 3   | -   | -   | -   | -   | 2    | 2    | -    | 3    |

1 - low, 2 - medium, 3 - high, '-' - no correlation

Prepared by  
by

Approved

| Course Code            | CourseName                                                  | Category              | Hours/Week               |   |   | C |
|------------------------|-------------------------------------------------------------|-----------------------|--------------------------|---|---|---|
|                        |                                                             |                       | L                        | T | P |   |
| 24AM457                | Natural Language Processing                                 | PC                    | 3                        | 0 | 2 | 4 |
| Regulation             | NatureoftheCourse                                           | Semester              | DataBook/Codes/Standards |   |   |   |
| 2024                   | THEORYCUMPRACTICAL                                          | V                     | -                        |   |   |   |
| Pre-requisiteCourse(s) |                                                             | Co-requisiteCourse(s) |                          |   |   |   |
| DataStructures         |                                                             | Machine Learning      |                          |   |   |   |
| CourseObjectives       |                                                             |                       |                          |   |   |   |
| 1                      | To introduce the fundamentals ofnatural language processing |                       |                          |   |   |   |
| 2                      | To understand text processing and language models           |                       |                          |   |   |   |
| 3                      | To learn syntactic andsemanticanalysis techniques           |                       |                          |   |   |   |
| 4                      | To apply machine learning methods in NLP                    |                       |                          |   |   |   |
| 5                      | To explore real-world NLP applications                      |                       |                          |   |   |   |

| <b>Course Outcomes</b><br>Upon completion of the course, students will be able to                                                                                                                            |                                                         |            |            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|------------|------------|
| C457.1                                                                                                                                                                                                       | Explain basic NLP concepts and preprocessing techniques |            | [U]        |
| C457.2                                                                                                                                                                                                       | Understand language models and tagging methods          |            | [U]        |
| C457.3                                                                                                                                                                                                       | Apply parsing and semantic analysis techniques          |            | [AP]       |
| C457.4                                                                                                                                                                                                       | Apply machine learning methods for NLP tasks            |            | [AP]       |
| C457.5                                                                                                                                                                                                       | Implement real-world NLP applications                   |            | [AP]       |
| <b>Course Contents</b>                                                                                                                                                                                       |                                                         |            |            |
| <b>Unit-1</b>                                                                                                                                                                                                | <b>INTRODUCTION TO NLP</b>                              | <b>C01</b> | <b>9+6</b> |
| Introduction to NLP – Challenges and Applications – Levels of Language Processing – Morphology – Syntax – Semantics – Pragmatics – NLP Pipeline – Text Preprocessing – Tokenization – Stop Word Removal.     |                                                         |            |            |
| <b>PRACTICAL:</b><br>1. Implementation of basic text preprocessing (Tokenization, Stop word removal)<br>2. Program for word frequency count in a document<br>3. Implementation of stemming and lemmatization |                                                         |            |            |
| <b>Unit-2</b>                                                                                                                                                                                                | <b>LANGUAGE MODELS AND TEXT PROCESSING</b>              | <b>C02</b> | <b>9+6</b> |
| N-gram Language Models – Probability Models – Smoothing Techniques – Part-of-Speech Tagging – Rule-based and Statistical Methods – Hidden Markov Models – Named Entity Recognition.                          |                                                         |            |            |
| <b>PRACTICAL:</b><br>1. Implement N-gram model for text prediction<br>2. Program for Part-of-Speech tagging<br>3. Implement Word Sense Disambiguation                                                        |                                                         |            |            |
| <b>Unit-3</b>                                                                                                                                                                                                | <b>SYNTACTIC AND SEMANTIC ANALYSIS</b>                  | <b>C03</b> | <b>9+6</b> |
| Parsing Techniques – Top-down and Bottom-up Parsing – Context Free Grammar – Dependency Parsing – Semantic Analysis – Word Sense Disambiguation – Lexical Semantics.                                         |                                                         |            |            |
| <b>PRACTICAL:</b><br>1. Implement parsing technique for sentence structure<br>2. Program for dependency parsing<br>3. Implement Word Sense Disambiguation                                                    |                                                         |            |            |
| <b>Unit-4</b>                                                                                                                                                                                                | <b>MACHINE LEARNING FOR NLP</b>                         | <b>C04</b> | <b>9+6</b> |
| Text Classification – Naive Bayes – Support Vector Machines – Feature Extraction – Bag of Words – TF-IDF – Sentiment Analysis – Evaluation Metrics.                                                          |                                                         |            |            |
| <b>PRACTICAL:</b><br>1. Implement text classification using Naive Bayes<br>2. Program for TF-IDF calculation<br>3. Perform sentiment analysis on sampled dataset                                             |                                                         |            |            |
| <b>Unit-5</b>                                                                                                                                                                                                | <b>ADVANCED NLP APPLICATIONS</b>                        | <b>C05</b> | <b>9+6</b> |
| Information Retrieval – Question Answering – Machine Translation – Chatbots – Word Embeddings – Deep Learning for NLP – Applications.                                                                        |                                                         |            |            |
| <b>PRACTICAL:</b><br>1. Develop a simple chatbot using predefined responses<br>2. Implement word embeddings using Word2Vec<br>3. Mini Project: Spam detection or text classification system                  |                                                         |            |            |
| <b>Total Theory Hours</b>                                                                                                                                                                                    |                                                         |            | <b>45</b>  |

| TotalPracticalHours    |                                                                                          | 30 |
|------------------------|------------------------------------------------------------------------------------------|----|
| <b>Textbooks:</b>      |                                                                                          |    |
| 1                      | Daniel Jurafsky & James H. Martin, Speech andLanguageProcessing,Pearson                  |    |
| 2                      | Steven Bird, Ewan Klein & Edward Loper, Natural Language Processing with Python,O'Reilly |    |
| <b>ReferenceBooks:</b> |                                                                                          |    |
| 1                      | Christopher D. Manning & Hinrich Schütze, Foundations of Statistical NLP, MIT Press      |    |
| 2                      | Jacob Eisenstein, Introduction to NLP, MIT Press                                         |    |
| 3                      | DipanjanSarkar, <i>TextAnalyticswithPython</i> , Apress                                  |    |
| <b>WebReferences:</b>  |                                                                                          |    |
| 1                      | <a href="https://nptel.ac.in/">https://nptel.ac.in/</a>                                  |    |
| 2                      | <a href="https://swayam.gov.in/">https://swayam.gov.in/</a>                              |    |

|   |                                                         |
|---|---------------------------------------------------------|
| 3 | <a href="https://ocw.mit.edu/">https://ocw.mit.edu/</a> |
| 4 | <a href="https://www.nltk.org">https://www.nltk.org</a> |

| BLOOM'S<br>TAXONOMY<br>LEVEL | ASSESSMENT-1 |          |          | ASSESSMENT-2       |                          | ASSIGNMENT | ATTENDANCE | END<br>SEMESTER<br>EXAMINATION |
|------------------------------|--------------|----------|----------|--------------------|--------------------------|------------|------------|--------------------------------|
|                              | CIA<br>1     | CIA<br>2 | MODEL    | LAB<br>EXPERIMENTS | MODE<br>LLA<br>B<br>EXAM |            |            |                                |
|                              | 6            | 6        | 8        | 10                 | 10                       |            |            |                                |
| Remember                     |              |          |          | 10                 | 10                       | 10         | 10         | 40                             |
| Understand                   | 40%          |          | 20%      |                    |                          |            |            |                                |
| Apply                        | 60%          | 100<br>% | 80%      |                    |                          |            |            |                                |
| Analyze                      |              |          |          |                    |                          |            |            |                                |
| Evaluate                     |              |          |          |                    |                          |            |            |                                |
| Create                       |              |          |          |                    |                          |            |            |                                |
| <b>Total(100Ma<br/>rks)</b>  | <b>6</b>     | <b>6</b> | <b>8</b> | <b>10</b>          | <b>10</b>                | <b>10</b>  | <b>10</b>  | <b>40</b>                      |

- CIA1,CIA2andModelExamwillbeconductedfor 50, 50and 100 marks. It shallbe subsequently converted to 6, 6 and8 marksrespectively.
- The Assignmentmarks will becomputed basedonAssignmentI,AssignmentIIandAssignmentIIImarks converted to10 marks.
- Experiment wise laboratory completion10 marks and Modellabexamwillbeconductedfor100marksand the same will be converted to10 marks.
- BTL mark split up may vary based on the nature ofthe subject.

| C0s/<br>POs | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PS<br>O<br>1 | PSO<br>2 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|--------------|----------|
| C455.1      | 3       | 2       | 2       | 2       | 2       | -       | -       | --      | -       | 2        | 2        | -            | 2        |
| C455.2      | 3       | 3       | 2       | 2       | 2       | -       | -       | -       | -       | 2        | 2        | -            | 3        |
| C455.3      | 3       | 3       | 3       | 2       | 2       | -       | -       | -       | -       | 2        | 2        | -            | 3        |
| C455.4      | 3       | 3       | 3       | 3       | 3       | -       | -       | -       | -       | 2        | 2        | -            | 3        |
| C455.5      | 3       | 3       | 3       | 3       | 3       | -       | -       | -       | -       | 2        | 2        | -            | 3        |

1-low,2-medium,3-high,'-'-nocorrelation

PreparedbyApprovedby

# **SYLLABUS OF SIXTH SEMESTER**

| Course Code                                                                                                                                                                                                                                                                                  | Course Name                                                                                                            | Category               | Hours/Week                |   |   | C         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|-----------|
|                                                                                                                                                                                                                                                                                              |                                                                                                                        |                        | L                         | T | P |           |
| 24AD461                                                                                                                                                                                                                                                                                      | ARTIFICIAL INTELLIGENCE-II                                                                                             | PC                     | 3                         | 0 | 0 | 3         |
| Regulation                                                                                                                                                                                                                                                                                   | Nature of the Course                                                                                                   | Semester               | Data Book/Codes/Standards |   |   |           |
| 2024                                                                                                                                                                                                                                                                                         | THEORY                                                                                                                 | VI                     | Nil                       |   |   |           |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                      |                                                                                                                        | Co-requisite Course(s) |                           |   |   |           |
| ARTIFICIAL INTELLIGENCE-I                                                                                                                                                                                                                                                                    |                                                                                                                        | Nil                    |                           |   |   |           |
| Course Objectives                                                                                                                                                                                                                                                                            |                                                                                                                        |                        |                           |   |   |           |
| 1                                                                                                                                                                                                                                                                                            | To know the underlying structure behind intelligence mathematically.                                                   |                        |                           |   |   |           |
| 2                                                                                                                                                                                                                                                                                            | To know the logical implications in probabilistic Reasoning.                                                           |                        |                           |   |   |           |
| 3                                                                                                                                                                                                                                                                                            | To know the automated learning techniques.                                                                             |                        |                           |   |   |           |
| 4                                                                                                                                                                                                                                                                                            | To explore the techniques in Reinforcement Learning.                                                                   |                        |                           |   |   |           |
| 5                                                                                                                                                                                                                                                                                            | To explore artificial intelligence techniques for Robotics.                                                            |                        |                           |   |   |           |
| Course Outcomes                                                                                                                                                                                                                                                                              |                                                                                                                        |                        |                           |   |   |           |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                      |                                                                                                                        |                        |                           |   |   |           |
| C461.1                                                                                                                                                                                                                                                                                       | Explain the probabilistic reasoning using Bayesian inference.                                                          |                        |                           |   |   | [U]       |
| C461.2                                                                                                                                                                                                                                                                                       | Apply appropriate Probabilistic reasoning techniques for solving uncertainty problems.                                 |                        |                           |   |   | [AP]      |
| C461.3                                                                                                                                                                                                                                                                                       | Apply probabilistic models for various use cases.                                                                      |                        |                           |   |   | [AP]      |
| C461.4                                                                                                                                                                                                                                                                                       | Apply Reinforcement Learning Techniques.                                                                               |                        |                           |   |   | [AP]      |
| C461.5                                                                                                                                                                                                                                                                                       | Apply AI techniques for robotics.                                                                                      |                        |                           |   |   | [AP]      |
| Course Contents                                                                                                                                                                                                                                                                              |                                                                                                                        |                        |                           |   |   |           |
| Unit-1                                                                                                                                                                                                                                                                                       | PROBABILISTIC REASONING I                                                                                              |                        |                           |   |   | C01 9Hrs  |
| Acting under uncertainty – Bayesian inference – naïve bayes models Probabilistic reasoning – Bayesian networks– exact inference in BN – approximate inference in BN – causal networks                                                                                                        |                                                                                                                        |                        |                           |   |   |           |
| Unit-2                                                                                                                                                                                                                                                                                       | PROBABILISTIC REASONING II                                                                                             |                        |                           |   |   | C02 9Hrs  |
| Probabilistic reasoning over time – time and uncertainty – inference in temporal models – Hidden Markov Models– Kalman filters – Dynamic Bayesian networks Probabilistic programming                                                                                                         |                                                                                                                        |                        |                           |   |   |           |
| Unit-3                                                                                                                                                                                                                                                                                       | DECISIONS UNDER UNCERTAINTY AND LEARNING PROBABILISTIC MODELS                                                          |                        |                           |   |   | C03 10Hrs |
| Basis of utility theory – utility functions – Multiattribute utility functions – decision networks – value of information– unknown preferences.                                                                                                                                              |                                                                                                                        |                        |                           |   |   |           |
| Statistical learning theory – maximum-likelihood parameter learning – naïve bayes models – generative and descriptive models – continuous models – Bayesian parameter learning – Bayesian linear regression – EM Algorithm– unsupervised clustering – Gaussian mixture models – learning HMM |                                                                                                                        |                        |                           |   |   |           |
| Unit-4                                                                                                                                                                                                                                                                                       | REINFORCEMENT LEARNING                                                                                                 |                        |                           |   |   | C04 9Hrs  |
| Learning from rewards – passive reinforcement learning – active reinforcement learning – generalization in reinforcement learning – policy search – inverse reinforcement learning – applications                                                                                            |                                                                                                                        |                        |                           |   |   |           |
| Unit-5                                                                                                                                                                                                                                                                                       | ROBOTICS                                                                                                               |                        |                           |   |   | C05 8Hrs  |
| Robots – robotic perception – planning movements – reinforcement learning in robotics – robotic frameworks – applications of robotics Philosophy, ethics, and safety of AI – the future of AI                                                                                                |                                                                                                                        |                        |                           |   |   |           |
| Total Hours                                                                                                                                                                                                                                                                                  |                                                                                                                        |                        |                           |   |   | 45        |
| Textbooks:                                                                                                                                                                                                                                                                                   |                                                                                                                        |                        |                           |   |   |           |
| 1                                                                                                                                                                                                                                                                                            | Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Fourth Edition, Pearson Education, 2020. |                        |                           |   |   |           |
| 2                                                                                                                                                                                                                                                                                            | Dan W. Patterson, “Introduction to A and ES”. Pearson Education, 2007                                                  |                        |                           |   |   |           |

|                         |                                                                                                                                 |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| <b>Reference Books:</b> |                                                                                                                                 |
| 1                       | Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008                                             |
| 2                       | Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006                                             |
| 3                       | Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013                                                     |
| <b>Web References:</b>  |                                                                                                                                 |
| 1                       | <a href="https://www.ibm.com/think/topics/artificial-intelligence">https://www.ibm.com/think/topics/artificial-intelligence</a> |
| 2                       | <a href="https://onlinecourses.nptel.ac.in/noc25_cs159/preview">https://onlinecourses.nptel.ac.in/noc25_cs159/preview</a>       |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 80%                   |                |                      |            |            |                          |
| Apply                                                       | 20%                   | 100%           | 100%                 |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C461.1      | 3    | 2    | 2    | 3    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 3     |
| C461.2      | 3    | 2    | 2    | 3    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 3     |
| C461.3      | 3    | 3    | 3    | 3    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 3     |
| C461.4      | 3    | 3    | 1    | 1    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 3     |
| C461.5      | 3    | 2    | 2    | 2    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                         | Course Name                                                                                                                   | Category               | Hours/Week                |   |             | C    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-------------|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                               |                        | L                         | T | P           |      |
| 24MB151                                                                                                                                                                                                                                                                                                                                                                                                                                             | PRINCIPLES OF MANAGEMENT                                                                                                      |                        | 3                         | 0 | 0           | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                          | Nature of the Course                                                                                                          | Semester               | Data Book/Codes/Standards |   |             |      |
| R24                                                                                                                                                                                                                                                                                                                                                                                                                                                 | THEORY                                                                                                                        | VII                    | -----                     |   |             |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                               | Co-requisite Course(s) |                           |   |             |      |
| -                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                               |                        |                           |   |             |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                               |                        |                           |   |             |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                   | To help students gain understanding on the basic concepts and functions of management.                                        |                        |                           |   |             |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                   | To provide them with tools and techniques of planning and decision-making process.                                            |                        |                           |   |             |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                   | To enable them to understand and apply the organizing functions in the organization.                                          |                        |                           |   |             |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                   | To help students analyze various techniques to lead and motivate employees                                                    |                        |                           |   |             |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                   | To acquire skills in coordination and controlling manpower and apply them in business scenario                                |                        |                           |   |             |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                               |                        |                           |   |             |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                               |                        |                           |   |             |      |
| CS151.1                                                                                                                                                                                                                                                                                                                                                                                                                                             | Comprehend the basic concepts of management and evolution in management.                                                      |                        |                           |   |             | [U]  |
| CS151.2                                                                                                                                                                                                                                                                                                                                                                                                                                             | Demonstrate the roles and skills in planning and decision making for the business.                                            |                        |                           |   |             | [AP] |
| CS151.3                                                                                                                                                                                                                                                                                                                                                                                                                                             | Execute grouping of activities via departmentation and discharge various roles and responsibilities in the organization       |                        |                           |   |             | [AP] |
| CS151.4                                                                                                                                                                                                                                                                                                                                                                                                                                             | Analyze and interpret the concepts of directing the workforce, improve performance through motivation & effective leadership. |                        |                           |   |             | [AN] |
| CS151.5                                                                                                                                                                                                                                                                                                                                                                                                                                             | Take effective steps in controlling & coordinating various resources in the organization                                      |                        |                           |   |             | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                               |                        |                           |   |             |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                              | INTRODUCTION TO MANAGEMENT                                                                                                    |                        |                           |   |             | 9    |
| Management: Meaning –Definitions –Nature-Scope-Distinction between Management and Administration. Management: A science or an art – Functions of Management- Levels of Management - Roles and Skills of a Manager-The evolution of Management Theory- (Scientific, human relations, system and contingency approaches), Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises             |                                                                                                                               |                        |                           |   |             |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                                              | PLANNING                                                                                                                      |                        |                           |   |             | 9    |
| Planning: Definition –Nature and Characteristics of Planning –Importance –Planning process-Types of Plans – Limitations. MBO- Definition –Process of MBO –Pros & Cons. Decision making: concept of decision and decision making - Decision making process - Types of Decisions, Factors affecting decisions                                                                                                                                         |                                                                                                                               |                        |                           |   |             |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                                              | ORGANISING                                                                                                                    |                        |                           |   |             | 9    |
| Organizing: Meaning- Definition –Nature & Importance-Types of Organization –Organizational structure- Span of control. Delegation: Meaning – importance –Centralization Vs Decentralization. Departmentation: Meaning –Bases of departmentation. Staffing: Meaning – Definition –Objectives, Factors affecting staffing, recruitment and selection.                                                                                                 |                                                                                                                               |                        |                           |   |             |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                                              | DIRECTING                                                                                                                     |                        |                           |   |             | 9    |
| Directing: Meaning-Nature-Importance –principles –Elements of Directing. Motivation –Motivation theories ( Maslow, Herzberg, ERG, X and Y theories) – Motivational techniques – Jobsatisfaction – Jobenrichment – Leadership – types and theories of leadership( Trait, Managerial Grid, Hersey Blanchard, Fiedler's Contingency Theories. Communication – Process of communication – Barrier in communication – Effective communication techniques |                                                                                                                               |                        |                           |   |             |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                                              | COORDINATION AND CONTROLLING                                                                                                  |                        |                           |   |             | 9    |
| Co-ordination & Controlling: Co-ordination: Meaning- Principles & Effective Coordination Techniques- Controlling: Definition – Characteristics of control – Steps in controlling –Controlling Techniques –Computer as a management tool, Latest trends in Management                                                                                                                                                                                |                                                                                                                               |                        |                           |   |             |      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                               |                        |                           |   | Total Hours | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                               |                        |                           |   |             |      |

|   |                                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------|
|   | P.C.Tripathy, P.N.Reddy, Ashish Bajpai Principles of Management, 7 <sup>th</sup> Edition, Tata McGraw Hill Education Pvt Ltd, New Delhi (2023) |
| 2 | Harold Knootz, Heinz Wehrhrich, Essentials of Management, 11 <sup>th</sup> Edition, Tata McGraw Hill Education Pvt Ltd, New Delhi. (2021)      |

| Reference Books: |                                                                                                                                                                                                                                                         |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                | Bhushan Y.K, Fundamentals of Business Organization and Management, Sultan Chand & Sons New Delhi (2016)                                                                                                                                                 |
| 2                | L.M.Prasad, Principles and Practice of Management, Himalaya Publication, Mumbai. (2019)                                                                                                                                                                 |
| Web References:  |                                                                                                                                                                                                                                                         |
| 1                | <a href="https://file-dhaka.portal.gov.bd/uploads/0283d03a-254c-4b8c-9db4-4060c02f16c2/629/c3c/ee6/629c3cee6adc6386614665.pdf">https://file-dhaka.portal.gov.bd/uploads/0283d03a-254c-4b8c-9db4-4060c02f16c2/629/c3c/ee6/629c3cee6adc6386614665.pdf</a> |
| 2                | <a href="https://www.freebookcentre.net/business-books-download/Introduction-to-Principles-of-Management.html">https://www.freebookcentre.net/business-books-download/Introduction-to-Principles-of-Management.html</a>                                 |
| 3                | <a href="https://s3.amazonaws.com/lumenlearning/success/waymaker/Waymaker-Principles-of-Management_regexified.pdf">https://s3.amazonaws.com/lumenlearning/success/waymaker/Waymaker-Principles-of-Management_regexified.pdf</a>                         |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | CONTINUOUS ASSESSMENT |                   |                         | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                   |                         | 10         | 10         | 60                       |
| Understand                                                  | 60%                   |                   | 20%                     |            |            |                          |
| Apply                                                       | 40%                   | 100%              | 80%                     |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P010 | P011 | PS01 | PS02 | PS03 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CS151.1     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |
| CS151.2     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |
| CS151.3     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |
| CS151.4     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |
| CS151.5     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |

| Course Code                                                                                                                                                                                                                                                             | Course Name                                                                                                | Category               | Hours/Week                |   |     | C      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-----|--------|
|                                                                                                                                                                                                                                                                         |                                                                                                            |                        | L                         | T | P   |        |
| 24AD477                                                                                                                                                                                                                                                                 | QUANTUM COMPUTING                                                                                          | PC                     | 3                         | 0 | 2   | 4      |
| Regulation                                                                                                                                                                                                                                                              | Nature of the Course                                                                                       | Semester               | Data Book/Codes/Standards |   |     |        |
| 2024                                                                                                                                                                                                                                                                    | THEORY CUM PRACTICAL                                                                                       | VI                     | -                         |   |     |        |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                 |                                                                                                            | Co-requisite Course(s) |                           |   |     |        |
| PROBABILITY AND STATISTICS                                                                                                                                                                                                                                              |                                                                                                            | MACHINE LEARNING       |                           |   |     |        |
| Course Objectives                                                                                                                                                                                                                                                       |                                                                                                            |                        |                           |   |     |        |
| 1                                                                                                                                                                                                                                                                       | To understand the mathematical foundations and quantum mechanical principles underlying quantum computing. |                        |                           |   |     |        |
| 2                                                                                                                                                                                                                                                                       | To learn the principles of quantum gates and quantum circuit construction.                                 |                        |                           |   |     |        |
| 3                                                                                                                                                                                                                                                                       | To study fundamental quantum algorithms and their computational significance.                              |                        |                           |   |     |        |
| 4                                                                                                                                                                                                                                                                       | To understand the basic concepts of quantum information theory.                                            |                        |                           |   |     |        |
| 5                                                                                                                                                                                                                                                                       | To gain knowledge of quantum cryptography and secure communication protocols.                              |                        |                           |   |     |        |
| Course Outcomes                                                                                                                                                                                                                                                         |                                                                                                            |                        |                           |   |     |        |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                 |                                                                                                            |                        |                           |   |     |        |
| C477.1                                                                                                                                                                                                                                                                  | Apply mathematical and quantum principles to represent quantum states.                                     |                        |                           |   |     | [AP]   |
| C477.2                                                                                                                                                                                                                                                                  | Construct quantum gates and circuits for computational tasks.                                              |                        |                           |   |     | [AP]   |
| C477.3                                                                                                                                                                                                                                                                  | Analyze fundamental quantum algorithms to solve computational problems.                                    |                        |                           |   |     | [AN]   |
| C477.4                                                                                                                                                                                                                                                                  | Demonstrate the application of quantum information theory concepts in communication systems.               |                        |                           |   |     | [AP]   |
| C477.5                                                                                                                                                                                                                                                                  | Analyze classical and quantum cryptographic protocols for secure communication.                            |                        |                           |   |     | [AN]   |
| Course Contents                                                                                                                                                                                                                                                         |                                                                                                            |                        |                           |   |     |        |
| Unit – 1                                                                                                                                                                                                                                                                | UNIT I QUANTUM COMPUTING BASIC CONCEPTS                                                                    |                        |                           |   | C01 | 9+6Hrs |
| Quantum-specific Linear Algebra – Complex Numbers – Vector Spaces – Dirac Notation – Matrices and Operators – Tensor Products – Postulates of Quantum Mechanics – Quantum Bits – Representation of Qubits – Superposition and Measurement.                              |                                                                                                            |                        |                           |   |     |        |
| PRACTICAL:                                                                                                                                                                                                                                                              |                                                                                                            |                        |                           |   |     |        |
| 1. Linear Algebra for Quantum States (Python Implementation)                                                                                                                                                                                                            |                                                                                                            |                        |                           |   |     |        |
| 2. Quantum State Simulation using Qiskit Statevector                                                                                                                                                                                                                    |                                                                                                            |                        |                           |   |     |        |
| Unit – 2                                                                                                                                                                                                                                                                | QUANTUM GATES AND CIRCUITS                                                                                 |                        |                           |   | C02 | 9+6Hrs |
| Universal Quantum Gates – Basic Single Qubit Gates – Multiple Qubit Gates – Quantum Circuit Development – Quantum Circuit Optimization – Basics of Quantum Error Correction.                                                                                            |                                                                                                            |                        |                           |   |     |        |
| PRACTICAL:                                                                                                                                                                                                                                                              |                                                                                                            |                        |                           |   |     |        |
| 3. Implementation of Single & Multi-Qubit Gate                                                                                                                                                                                                                          |                                                                                                            |                        |                           |   |     |        |
| 4. Quantum Circuit Construction & Optimization                                                                                                                                                                                                                          |                                                                                                            |                        |                           |   |     |        |
| Unit – 3                                                                                                                                                                                                                                                                | QUANTUM ALGORITHMS                                                                                         |                        |                           |   | C03 | 9+9Hrs |
| Quantum Parallelism – Deutsch Algorithm – Deutsch–Jozsa Algorithm – Quantum Fourier Transform and Applications – Quantum Search Algorithms: Grover’s Algorithm – Introduction to Shor’s Factoring Algorithm – Comparative Analysis of Classical and Quantum Algorithms. |                                                                                                            |                        |                           |   |     |        |
| PRACTICAL                                                                                                                                                                                                                                                               |                                                                                                            |                        |                           |   |     |        |
| 5. Implementation of Deutsch & Deutsch–Jozsa Algorithms                                                                                                                                                                                                                 |                                                                                                            |                        |                           |   |     |        |
| 6. Implementation of Grover’s Search Algorithm                                                                                                                                                                                                                          |                                                                                                            |                        |                           |   |     |        |
| 7. Conceptual Implementation of Shor’s Algorithm                                                                                                                                                                                                                        |                                                                                                            |                        |                           |   |     |        |
| Unit – 4                                                                                                                                                                                                                                                                | QUANTUM INFORMATION THEORY                                                                                 |                        |                           |   | C04 | 9+6Hrs |
| Data Compression – Shannon Entropy – Shannon’s Noiseless Channel Coding Theorem – Schumacher’s Quantum Noiseless Channel Coding Theorem – Density Matrix Representation – Classical Information                                                                         |                                                                                                            |                        |                           |   |     |        |

|                                                                                                                                                                                                                              |                                                                                                                                         |            |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|------------|---------------|
| over Noisy Quantum Channels – Quantum Information Measures.                                                                                                                                                                  |                                                                                                                                         |            |               |
| <b>PRACTICAL:</b>                                                                                                                                                                                                            |                                                                                                                                         |            |               |
| 8. Shannon Entropy & Data Compression (Python)                                                                                                                                                                               |                                                                                                                                         |            |               |
| 9. Quantum Information & Density Matrix Representation                                                                                                                                                                       |                                                                                                                                         |            |               |
| <b>Unit – 5</b>                                                                                                                                                                                                              | <b>QUANTUM CRYPTOGRAPHY AND APPLICATIONS</b>                                                                                            | <b>C05</b> | <b>9+3Hrs</b> |
| Classical Cryptography Basic Concepts – Private Key Cryptography – Quantum Key Distribution – BB84 Protocol – E91 Protocol – Applications of Quantum Computing in Secure Communication, Optimization, and Machine Learning.. |                                                                                                                                         |            |               |
| <b>PRACTICAL:</b>                                                                                                                                                                                                            |                                                                                                                                         |            |               |
| 10 . Quantum Key Distribution (BB84 Protocol Simulation)                                                                                                                                                                     |                                                                                                                                         |            |               |
| <b>Total Theory Hours</b>                                                                                                                                                                                                    |                                                                                                                                         |            | <b>45</b>     |
| <b>Total Practical Hours</b>                                                                                                                                                                                                 |                                                                                                                                         |            | <b>30</b>     |
| <b>Textbooks:</b>                                                                                                                                                                                                            |                                                                                                                                         |            |               |
| 1                                                                                                                                                                                                                            | Parag K. Lala, “Quantum Computing: A Beginner’s Introduction”, First Edition, McGraw-Hill Education, 2020.                              |            |               |
| 2                                                                                                                                                                                                                            | Michael A. Nielsen, Issac L. Chuang, “Quantum Computation and Quantum Information”, Tenth Edition, Cambridge University Press, 2010.    |            |               |
| 3                                                                                                                                                                                                                            | Chris Bernhardt, Quantum Computing for Everyone, Reprint Edition (8 September 2020), The MIT Press, 2020.                               |            |               |
| 4                                                                                                                                                                                                                            | Robert Lored, Learn Quantum Computing with Python and IBM Quantum, Second Edition, Packt Publishing, 2025.                              |            |               |
| <b>Reference Books:</b>                                                                                                                                                                                                      |                                                                                                                                         |            |               |
| 1                                                                                                                                                                                                                            | Hassi Norlén, Quantum Computing in Practice with Qiskit® and IBM Quantum Experience, Packt Publishing Ltd., 2020.                       |            |               |
| 2                                                                                                                                                                                                                            | Robert S. Sutor, Dancing with Qubits: How Quantum Computing Works and How It Can Change the World, Packt Publishing Ltd., 2019          |            |               |
| <b>Web References:</b>                                                                                                                                                                                                       |                                                                                                                                         |            |               |
| 1                                                                                                                                                                                                                            | <a href="https://onlinecourses-archive.nptel.ac.in/noc17_ph05/preview">https://onlinecourses-archive.nptel.ac.in/noc17_ph05/preview</a> |            |               |
| 2                                                                                                                                                                                                                            | <a href="https://onlinecourses.nptel.ac.in/noc25_cs95/">https://onlinecourses.nptel.ac.in/noc25_cs95/</a>                               |            |               |

| BLOOM'S TAXONOMY LEVEL  | ASSESSMENT-1 |          |          | ASSESSMENT-2    |                | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|-------------------------|--------------|----------|----------|-----------------|----------------|------------|------------|--------------------------|
|                         | CIA1         | CIA2     | MODEL    | LAB EXPERIMENTS | MODEL LAB EXAM |            |            |                          |
|                         | 6            | 6        | 8        | 15              | 5              |            |            |                          |
| Remember                |              |          |          | 15              | 5              | 10         | 10         | 40                       |
| Understand              |              |          |          |                 |                |            |            |                          |
| Apply                   | 100          | 100      | 100      |                 |                |            |            |                          |
| Analyze                 |              |          |          |                 |                |            |            |                          |
| Evaluate                |              |          |          |                 |                |            |            |                          |
| Create                  |              |          |          |                 |                |            |            |                          |
| <b>Total (100Marks)</b> | <b>6</b>     | <b>6</b> | <b>8</b> | <b>15</b>       | <b>5</b>       | <b>10</b>  | <b>10</b>  | <b>40</b>                |

CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.

The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 marks.

Experiment wise laboratory completion 15 marks and Model lab exam will be conducted for 100 marks and the same will be converted to 5 marks.

BTL mark split up may vary based on the nature of the subject.

| C0s/<br>POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PSO<br>2 | PSO<br>3 |
|-------------|-----|-----|-----|-----|-----|-----|---------|---------|---------|----------|----------|----------|----------|----------|
| C477.1      | 3   | 3   | 3   | 3   | 3   | -   | -       | -       | -       | -        | 1        | 3        | 3        | 2        |
| C477.2      | 3   | 3   | 2   | 3   | 3   | -   | -       | -       | -       | -        | 1        | 2        | 3        | 2        |
| C477.3      | 3   | 3   | 2   | 2   | 3   | -   | -       | -       | -       | -        | 2        | 3        | 2        | 2        |
| C477.4      | 3   | 3   | 3   | 2   | 3   | -   | -       | -       | -       | -        | 2        | 2        | 2        | 2        |
| C477.5      | 3   | 3   | 3   | 3   | 3   | -   | -       | -       | -       | -        | 2        | 3        | 3        | 2        |

1 - low, 2 - medium, 3 - high, '-' - no correlation

## **SCHEME**

### **SCHEME OF PROFESSIONAL ELECTIVES**

# **VERTICAL ANALYTICS ENGINEERING**

| Course Code                                                                                                                                                                                                                                                                                                                                                                                       | Course Name                                                                                                    | Category               | Hours/Week                |   |   | C        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----------|
|                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                |                        | L                         | T | P |          |
| 24AD501                                                                                                                                                                                                                                                                                                                                                                                           | EXPLORATORY DATA ANALYSIS                                                                                      | PE                     | 3                         | 0 | 0 | 3        |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                        | Nature of the Course                                                                                           | Semester               | Data Book/Codes/Standards |   |   |          |
| 2024                                                                                                                                                                                                                                                                                                                                                                                              | THEORY                                                                                                         | -                      | -                         |   |   |          |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                | Co-requisite Course(s) |                           |   |   |          |
| DATA EXPLORATION AND VISUALIZATION                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                | -                      |                           |   |   |          |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                                                                 | To introduce the concepts and importance of Exploratory Data Analysis in the data science workflow             |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                                                                 | To enable students to understand different types of data and statistical measures used for analyzing datasets  |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                                                                                 | To analyze relationships among variables using statistical and visualization techniques                        |                        |                           |   |   |          |
| 4                                                                                                                                                                                                                                                                                                                                                                                                 | To apply various graphical methods and visualization techniques for interpreting data patterns.                |                        |                           |   |   |          |
| 5                                                                                                                                                                                                                                                                                                                                                                                                 | To perform exploratory analysis on real-world datasets and derive meaningful insights.                         |                        |                           |   |   |          |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                |                        |                           |   |   |          |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                           |                                                                                                                |                        |                           |   |   |          |
| C501.1                                                                                                                                                                                                                                                                                                                                                                                            | Understand the concepts, data types and statistical measures used in exploratory data analysis.                |                        |                           |   |   | [U]      |
| C501.2                                                                                                                                                                                                                                                                                                                                                                                            | Apply techniques to analyze relationships between variables using statistical measures and contingency tables. |                        |                           |   |   | [AP]     |
| C501.3                                                                                                                                                                                                                                                                                                                                                                                            | Apply visualization principles to represent relationships and patterns in datasets.                            |                        |                           |   |   | [AP]     |
| C501.4                                                                                                                                                                                                                                                                                                                                                                                            | Explore datasets using statistical graphs and visualization techniques                                         |                        |                           |   |   | [AP]     |
| C501.5                                                                                                                                                                                                                                                                                                                                                                                            | Predict exploratory analysis on real-world datasets and interpret results for decision making.                 |                        |                           |   |   | [AP]     |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                |                        |                           |   |   |          |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                            | INTRODUCTION TO EXPLORATORY DATA ANALYSIS                                                                      |                        |                           |   |   | C01 9Hrs |
| Introduction to Exploratory Data Analysis (EDA) – Importance of EDA in data science – Types of data: numerical and categorical data – Discrete and continuous variables – Distribution of variables – Numerical summaries of data: measures of central tendency and dispersion – Scaling and standardizing data – Inequality measures – Introduction to smoothing techniques in time series data. |                                                                                                                |                        |                           |   |   |          |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                            | ANALYSIS OF RELATIONSHIPS IN DATA                                                                              |                        |                           |   |   | C02 9Hrs |
| Relationships between two variables – Scatter plots and correlation – Percentage tables and contingency tables – Analysing relationships in categorical data – Handling multiple datasets – Transformation of variables – Introducing a third variable – Basic causal interpretation – Three-variable contingency tables – Introduction to longitudinal data analysis.                            |                                                                                                                |                        |                           |   |   |          |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                            | DATA VISUALIZATION PRINCIPLES                                                                                  |                        |                           |   |   | C03 9Hrs |
| Principles of data visualization – Stages of visualizing data – Mapping data to visual elements – Visualizing relationships and correlations – Scatter plot maps – Visualization of hierarchies and trees – Network and graph visualization – Data acquisition and parsing for visualization.                                                                                                     |                                                                                                                |                        |                           |   |   |          |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                            | STATISTICAL GRAPHS AND VISUAL ANALYSIS                                                                         |                        |                           |   |   | C04 9Hrs |
| Histograms and density curves – Frequency polygons – Box plots and violin plots – Dot plots for grouped data – Two-dimensional density plots – Correlation matrix visualization – Heatmaps – Three-dimensional scatter plots – Dendrograms – Q-Q plots and mosaic plots.                                                                                                                          |                                                                                                                |                        |                           |   |   |          |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                            | APPLICATIONS OF DATA EXPLORATION                                                                               |                        |                           |   |   | C05 9Hrs |
| Applications of EDA in real-world datasets – Data handling and preprocessing – Loading and transforming datasets – Creating tidy data – Basic exploratory analysis workflow – Visualization for decision making – Case study: Analysis of student academic performance data.                                                                                                                      |                                                                                                                |                        |                           |   |   |          |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                |                        |                           |   |   | 45       |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                                                                 | Suresh Kumar Mukhiya, Usman Ahmed, Hands-On Exploratory Data Analysis with Python, Packt                       |                        |                           |   |   |          |

|                         |                                                                                                            |
|-------------------------|------------------------------------------------------------------------------------------------------------|
|                         | Publishing, 2020.                                                                                          |
| 2                       | W. Martinez, A. Martinez, J. L. Solka, Exploratory Data Analysis with MATLAB, CRC Press, 3rd Edition, 2017 |
| <b>Reference Books:</b> |                                                                                                            |
| 1                       | Michael Jambu, Exploratory and Multivariate Data Analysis, Academic Press                                  |
| 2                       | Charu C. Aggarwal, Data Mining: The Textbook, Springer, 2015                                               |
|                         | Craig K. Enders, Applied Missing Data Analysis, The Guilford Press, 2010.                                  |
| <b>Web References:</b>  |                                                                                                            |
| 1                       | Kaggle – <a href="https://www.kaggle.com/learn">https://www.kaggle.com/learn</a>                           |
| 2                       | Towards Data Science – <a href="https://towardsdatascience.com">https://towardsdatascience.com</a>         |
| 3                       | Scikit-learn Documentation – <a href="https://scikit-learn.org">https://scikit-learn.org</a>               |
| 4                       | Pandas Documentation – <a href="https://pandas.pydata.org">https://pandas.pydata.org</a>                   |
| 5                       | Matplotlib Documentation – <a href="https://matplotlib.org">https://matplotlib.org</a>                     |
| 6                       | Seaborn Documentation – <a href="https://seaborn.pydata.org">https://seaborn.pydata.org</a>                |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 60%                   |                | 20%                  |            |            |                          |
| Apply                                                       | 40%                   | 100%           | 80%                  |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C501.1      | 3    | 2    | -    | -    | 1    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 2     |
| C501.2      | 3    | 3    | 1    | 2    | 2    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 2     |
| C501.3      | 2    | 3    | 2    | 2    | 3    | -    | -    | -    | -    | -     | 2     | 3     | 2     | 2     |
| C501.4      | 2    | 3    | 2    | 3    | 3    | -    | -    | -    | -    | -     | 2     | 3     | 2     | 2     |
| C501.5      | 2    | 3    | 3    | 3    | 3    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                           | Course Name                                                                                                                                       | Category               | Hours/Week                |   |   | C    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|
|                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                   |                        | L                         | T | P |      |
| 24AD502                                                                                                                                                                                                                                                                                                                               | IMAGE AND VIDEO ANALYTICS                                                                                                                         | PE                     | 3                         | 0 | 0 | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                            | Nature of the Course                                                                                                                              | Semester               | Data Book/Codes/Standards |   |   |      |
| 2024                                                                                                                                                                                                                                                                                                                                  | THEORY                                                                                                                                            | -                      | -----                     |   |   |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                               |                                                                                                                                                   | Co-requisite Course(s) |                           |   |   |      |
| -                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                   | -                      |                           |   |   |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                   |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                     | To understand the basics of image processing techniques for computer vision.                                                                      |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                     | To learn the techniques used for image pre-processing.                                                                                            |                        |                           |   |   |      |
| 3                                                                                                                                                                                                                                                                                                                                     | To discuss the various object detection techniques.                                                                                               |                        |                           |   |   |      |
| 4                                                                                                                                                                                                                                                                                                                                     | To understand the various Object recognition mechanisms.                                                                                          |                        |                           |   |   |      |
| 5                                                                                                                                                                                                                                                                                                                                     | To elaborate on the video analytics techniques.                                                                                                   |                        |                           |   |   |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                   |                        |                           |   |   |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                               |                                                                                                                                                   |                        |                           |   |   |      |
| C502.1                                                                                                                                                                                                                                                                                                                                | Understand the basics of image processing techniques for computer vision and video analysis.                                                      |                        |                           |   |   | [U]  |
| C502.2                                                                                                                                                                                                                                                                                                                                | Explain the techniques used for image pre-processing.                                                                                             |                        |                           |   |   | [U]  |
| C502.3                                                                                                                                                                                                                                                                                                                                | Apply Various object detection techniques to solve real world image analysis problems.                                                            |                        |                           |   |   | [AP] |
| C502.4                                                                                                                                                                                                                                                                                                                                | Apply various face recognition mechanisms to develop and implement real world recognition systems.                                                |                        |                           |   |   | [AP] |
| C502.5                                                                                                                                                                                                                                                                                                                                | Apply deep learning techniques to analyze and interpret video data for real world video analytics applications.                                   |                        |                           |   |   | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                   |                        |                           |   |   |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                | INTRODUCTION TO IMAGE ANALYTICS                                                                                                                   |                        |                           |   |   | 9    |
| Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation- Traditional and Hierarchical image data structures.                                                                    |                                                                                                                                                   |                        |                           |   |   |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                | IMAGE PRE-PROCESSING                                                                                                                              |                        |                           |   |   | 9    |
| Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models - Edges in multi-spectral images - Local pre-processing in the frequency domain - Line detection by local pre-processing operators - Image restoration. |                                                                                                                                                   |                        |                           |   |   |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                | OBJECT DETECTION USING MACHINE LEARNING                                                                                                           |                        |                           |   |   | 9    |
| Object detection– Object detection methods – Deep Learning framework for Object detection– bounding box approach - Intersection over Union (IoU) – Deep Learning Architectures- R-CNN- Faster R-CNN- You Only Look Once (YOLO) – Salient features - Loss Functions - YOLO architectures                                               |                                                                                                                                                   |                        |                           |   |   |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                | FACE RECOGNITION AND GESTURE RECOGNITION                                                                                                          |                        |                           |   |   | 9    |
| Face Recognition- Introduction- Applications of Face Recognition- Process of Face Recognition- DeepFace solution by Facebook- FaceNet for Face Recognition- Implementation using FaceNet- Gesture Recognition.                                                                                                                        |                                                                                                                                                   |                        |                           |   |   |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                | VIDEO ANALYTICS                                                                                                                                   |                        |                           |   |   | 9    |
| Video Processing – use cases of video analytics- Vanishing Gradient and exploding gradient problem- ResNet architecture- ResNet and skip connections- Inception Network- GoogleNet architecture- Improvement in Inception v2 - Video analytics- ResNet and Inception v3.                                                              |                                                                                                                                                   |                        |                           |   |   |      |
| Total Hours                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                   |                        |                           |   |   | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                   |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                     | Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 4th edition, Thomson Learning, 2013.                   |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                     | Vaibhav Verdhani, (2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras, Apress 2021 (UNIT-III, IV and V) |                        |                           |   |   |      |
| Reference Books:                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                   |                        |                           |   |   |      |

|   |                                                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------------|
| 1 | Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London Limited, 2011.             |
| 2 | Caifeng Shan, Fatih Porikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", Springer, 2012. |
| 3 | D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003.                             |
| 4 | E. R. Davies, (2012), "Computer & Machine Vision", Fourth Edition, Academic Press.                                  |

**Web References:**

|   |                                                                                           |
|---|-------------------------------------------------------------------------------------------|
| 1 | <a href="https://nptel.ac.in/courses/106101061">https://nptel.ac.in/courses/106101061</a> |
| 2 | <a href="https://nptel.ac.in/courses/106105087">https://nptel.ac.in/courses/106105087</a> |
| 3 | <a href="https://nptel.ac.in/courses/106105182">https://nptel.ac.in/courses/106105182</a> |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                                                    |                       |                   |                         | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand                                                  | 100%                  | 20%               | 30%                     |            |            |                          |
| Apply                                                       |                       | 80%               | 70%                     |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| Total (100 Marks)                                           | 6                     | 6                 | 8                       | 10         | 10         | 60                       |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C502.1      | 3    | 1    | 2    | 2    | -    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 3     |
| C502.2      | 2    | 2    | 3    | 3    | -    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 2     |
| C502.3      | 1    | 2    | 2    | 2    | -    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 3     |
| C502.4      | 1    | 2    | 3    | 2    | -    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 2     |
| C502.5      | 3    | 2    | 1    | 3    | -    | -    | -    | -    | -    | -     | 2     | 3     | 2     | 2     |

| Course Code                                                                                                                                                                                                                                                                                                                                              | Course Name                                                                                                                | Category               | Hours/Week                |   |             | C    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-------------|------|
|                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                            |                        | L                         | T | P           |      |
| 24AD503                                                                                                                                                                                                                                                                                                                                                  | HEALTHCARE ANALYTICS                                                                                                       | PE                     | 3                         | 0 | 0           | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                               | Nature of the Course                                                                                                       | Semester               | Data Book/Codes/Standards |   |             |      |
| 2024                                                                                                                                                                                                                                                                                                                                                     | THEORY                                                                                                                     |                        | -                         |   |             |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                  |                                                                                                                            | Co-requisite Course(s) |                           |   |             |      |
| -                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            | -                      |                           |   |             |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            |                        |                           |   |             |      |
| 1                                                                                                                                                                                                                                                                                                                                                        | Understand the health data formats, health care policy and standards                                                       |                        |                           |   |             |      |
| 2                                                                                                                                                                                                                                                                                                                                                        | Learn the significance and need of data analysis and data visualization                                                    |                        |                           |   |             |      |
| 3                                                                                                                                                                                                                                                                                                                                                        | Understand the health data management frameworks                                                                           |                        |                           |   |             |      |
| 4                                                                                                                                                                                                                                                                                                                                                        | Learn the use of machine learning and deep learning algorithms in healthcare                                               |                        |                           |   |             |      |
| 5                                                                                                                                                                                                                                                                                                                                                        | Apply healthcare analytics for critical care applications                                                                  |                        |                           |   |             |      |
| Course Outcomes --- Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                              |                                                                                                                            |                        |                           |   |             |      |
| C503.1                                                                                                                                                                                                                                                                                                                                                   | Understand machine learning and deep learning algorithms for health data analysis                                          |                        |                           |   |             | [U]  |
| C503.2                                                                                                                                                                                                                                                                                                                                                   | Apply the data management techniques for healthcare data                                                                   |                        |                           |   |             | [AP] |
| C503.3                                                                                                                                                                                                                                                                                                                                                   | Examine the need of healthcare data analysis in e-healthcare, telemedicine and other critical care applications            |                        |                           |   |             | [AP] |
| C503.4                                                                                                                                                                                                                                                                                                                                                   | Design health data analytics for real time applications                                                                    |                        |                           |   |             | [AP] |
| C503.5                                                                                                                                                                                                                                                                                                                                                   | Use emergency care system using health data analysis                                                                       |                        |                           |   |             | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                          |                                                                                                                            |                        |                           |   |             |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                   | INTRODUCTION TO HEALTHCARE ANALYSIS                                                                                        |                        |                           |   | C01         | 9    |
| Overview - History of Healthcare Analysis Parameters on medical care systems- Need for Healthcare Analytics - Foundations of Healthcare Analytics-Healthcare privacy and ethics, Healthcare laws and Acts-Standardized codesets- Machine Learning Foundations: Tree Like reasoning , Probabilistic reasoning and Bayes Theorem                           |                                                                                                                            |                        |                           |   |             |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                   | ANALYTICS ON MACHINE LEARNING                                                                                              |                        |                           |   | C02         | 9    |
| Machine Learning Pipeline-Pre-processing-Visualization-Feature Selection-Training model parameter-Evaluation model:Sensitivity ,Specificity ,PPV ,NPV,FPR ,Accuracy ,ROC ,Precision Recall Curves ,Value of target variables -Python Introduction - Pandas Data Frame Operations -Seaborn introduction,Seaborn Vs Matplotlib-Plots for categorical data. |                                                                                                                            |                        |                           |   |             |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                   | HEALTHCARE MANAGEMENT                                                                                                      |                        |                           |   | C03         | 9    |
| IoT-Smart Sensors-Decision Support System-Medicare value-based programs-Matrix block Cipher System-Semantic Framework Analysis-Histogram bin Shifting and Rc6 Encryption-Clinical Prediction Models-Visual Analytics for Healthcare.                                                                                                                     |                                                                                                                            |                        |                           |   |             |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                   | HEALTHCARE AND DEEP LEARNING                                                                                               |                        |                           |   | C04         | 9    |
| Introduction on Deep Learning- DFF network CNN- RNN for Sequences- Biomedical Image and Signal Analysis-Natural Language Processing and Data Mining for Clinical Data -Mobile imaging and Analytics-Clinical Decision Support System.                                                                                                                    |                                                                                                                            |                        |                           |   |             |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                   | HEALTHCARE ANALYTICS APPLICATIONS & CASE STUDIES                                                                           |                        |                           |   | C05         | 9    |
| Introduction - Descriptive Analytics Applications - Predictive Analytics Applications - Prescriptive Analytics Application Predicting Mortality for cardiology Practice-Smart Ambulance System using IoT-Hospital Acquired Conditions (HAC) program- Healthcare and Emerging Technologies - ECG Data Analysis.                                           |                                                                                                                            |                        |                           |   |             |      |
|                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                            |                        |                           |   | Total Hours | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                               |                                                                                                                            |                        |                           |   |             |      |
| 1                                                                                                                                                                                                                                                                                                                                                        | Chandan K.Reddy, Charu C. Aggarwal, "Health Care data Analysis", First edition, CRC, 2015.                                 |                        |                           |   |             |      |
| 2                                                                                                                                                                                                                                                                                                                                                        | Hui Jang, Eva K.Lee, "Health Care Analysis: From Data to Knowledge to Healthcare Improvement", First Edition, Wiley, 2016. |                        |                           |   |             |      |
| 3                                                                                                                                                                                                                                                                                                                                                        | Vikas Kumar, "Health Care Analysis Made Simple", Packt Publishing, 2018.                                                   |                        |                           |   |             |      |
| Reference Books:                                                                                                                                                                                                                                                                                                                                         |                                                                                                                            |                        |                           |   |             |      |
| 1                                                                                                                                                                                                                                                                                                                                                        | Nilanjan Dey, Amira Ashour , Simon James Fong, Chintan Bhatl, "Health Care Data Analysis and                               |                        |                           |   |             |      |

|                        |                                                                                                                                                                                                 |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | Management, First Edition, Academic Press, 2018.                                                                                                                                                |
| 2                      | Kulkarni, Siarry, Singh, Abraham, Zhang, Zomaya, Baki, "Big Data Analytics in Health Care", Springer, 2020.                                                                                     |
| 3                      | Dinov, Ivo D. "Data Science and Predictive Analytics." Springer, Ann Arbor, MI, USA<br><a href="https://doi.org/10.1007/978-1-4939-9832-7">https://doi.org/10.1007/978-1-4939-9832-7</a> (2018) |
| 4                      | El Morr, Christo, and Hossam Ali-Hassan. Analytics in healthcare: a practical introduction. Springer, 2019.                                                                                     |
| <b>Web References:</b> |                                                                                                                                                                                                 |
| 1                      | <a href="https://scikit-learn.org/stable">https://scikit-learn.org/stable</a>                                                                                                                   |
| 2                      | <a href="https://www.tensorflow.org/">https://www.tensorflow.org/</a>                                                                                                                           |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 80%                   | 100%           | 20%                  |            |            |                          |
| Apply                                                       | 20%                   |                | 80%                  |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PS01 | PS02 | PS03 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| C503-1      | 3   | 3   | 3   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | 2    | 2    |
| C503-2      | 3   | 1   | 1   | 3   | -   | -   | -   | -   | -   | -    | 3    | 3    | 3    | 3    |
| C503-3      | 2   | 1   | 2   | 1   | -   | -   | -   | -   | -   | -    | 1    | 3    | 2    | 2    |
| C503-4      | 2   | 2   | 3   | 3   | -   | -   | -   | -   | -   | -    | 1    | 3    | 2    | 2    |
| C503-5      | 1   | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | 3    | 2    | 2    | 2    |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                | Course Name                                                                                                                                                                                                                             | Category               | Hours/Week                |   |     | C    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-----|------|
|                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                         |                        | L                         | T | P   |      |
| 24AD504                                                                                                                                                                                                                                                                                                                                                                    | TEXT AND SPEECH ANALYSIS                                                                                                                                                                                                                | PE                     | 3                         | 0 | 0   | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                 | Nature of the Course                                                                                                                                                                                                                    | Semester               | Data Book/Codes/Standards |   |     |      |
| 2024                                                                                                                                                                                                                                                                                                                                                                       | THEORY                                                                                                                                                                                                                                  |                        | NIL                       |   |     |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                         | Co-requisite Course(s) |                           |   |     |      |
| Machine Learning                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                         | Deep Learning          |                           |   |     |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                          | To understand fundamental NLP concepts and text representation techniques.                                                                                                                                                              |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                          | To apply embeddings and deep learning models for text classification and analysis.                                                                                                                                                      |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                                                                          | To design and evaluate question answering and dialogue systems.                                                                                                                                                                         |                        |                           |   |     |      |
| 4                                                                                                                                                                                                                                                                                                                                                                          | To study techniques for text-to-speech synthesis using signal processing and deep learning methods.                                                                                                                                     |                        |                           |   |     |      |
| 5                                                                                                                                                                                                                                                                                                                                                                          | To develop automatic speech recognition systems and evaluate their performance.                                                                                                                                                         |                        |                           |   |     |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| C504.1                                                                                                                                                                                                                                                                                                                                                                     | Explain existing and emerging deep learning architectures for text and speech Processing                                                                                                                                                |                        |                           |   |     | [U]  |
| C504.2                                                                                                                                                                                                                                                                                                                                                                     | Implement text classification using embeddings and deep learning.                                                                                                                                                                       |                        |                           |   |     | [AP] |
| C504.3                                                                                                                                                                                                                                                                                                                                                                     | Apply question answering and dialogue systems.                                                                                                                                                                                          |                        |                           |   |     | [AP] |
| C504.4                                                                                                                                                                                                                                                                                                                                                                     | Apply text-to-speech synthesis systems.                                                                                                                                                                                                 |                        |                           |   |     | [AP] |
| C504.5                                                                                                                                                                                                                                                                                                                                                                     | Use speech recognition systems.                                                                                                                                                                                                         |                        |                           |   |     | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                     | NATURAL LANGUAGE BASICS                                                                                                                                                                                                                 |                        |                           |   | C01 | 9Hrs |
| Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling– Text tokenization – Stemming – Lemmatization – Removing stop words– Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model – Text Similarity (Similarity Metrics used in Text Analytics).                     |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                     | TEXT CLASSIFICATION                                                                                                                                                                                                                     |                        |                           |   | C02 | 9Hrs |
| Vector Semantics and Embeddings– Word Embeddings– Word2Vec Model– GloVe Model– FastText Model– Overview of Deep Learning Models– Recurrent Neural Networks (RNN) – Long Short-Term Memory (LSTM) – Transformers Architecture – Attention Mechanism – Introduction to BERT – Applications of BERT in Text Classification – Overview of Text Summarization and Topic Models. |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                     | QUESTION ANSWERING AND DIALOGUE SYSTEMS                                                                                                                                                                                                 |                        |                           |   | C03 | 9Hrs |
| Information Retrieval – IR-based Question Answering – Knowledge-based Question Answering – Language Models for QA– Classical QA Models– Transformer-based Question Answering– BERT-based QA Models– Chatbots– Design of Dialogue Systems – Evaluation of Dialogue Systems.                                                                                                 |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                     | TEXT-TO-SPEECH SYNTHESIS                                                                                                                                                                                                                |                        |                           |   | C04 | 9Hrs |
| SYNTHESIS Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing – Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems.                                                                                                                                                                                        |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                     | AUTOMATIC SPEECH RECOGNITION                                                                                                                                                                                                            |                        |                           |   | C05 | 9Hrs |
| Speech recognition: Feature Extraction – Acoustic modeling – HMM (Hidden Markov Models), HMM-DNN systems – Language Models– LSTM– Decoding Strategies– Evaluation of ASR systems– Word Error rate, Recognition accuracy.                                                                                                                                                   |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                         |                        |                           |   |     | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                          | Daniel Jurafsky and James H. Martin, <i>Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition with Language Models</i> , Third Edition Draft, January 2026. |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                          | Steven Bird, Ewan Klein, and Edward Loper, <i>Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit</i> , O'Reilly Media, Updated Reprint Edition, 2017.                                            |                        |                           |   |     |      |

| Reference Books: |                                                                                                                                                                                                     |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                | Lewis Tunstall, Leandro von Werra, and Thomas Wolf, <i>Natural Language Processing with Transformers: Building Language Applications with Hugging Face</i> , Revised Edition, O'Reilly Media, 2022. |
| 2                | Ian Goodfellow, Yoshua Bengio, and Aaron Courville, <i>Deep Learning</i> , The MIT Press, 2016 (latest widely used edition).                                                                        |
| 3                | Lawrence Rabiner and Biing-Hwang Juang, <i>Fundamentals of Speech Recognition</i> , Prentice Hall, 1993 (classic foundational edition).                                                             |
| 4                | Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze, <i>Introduction to Information Retrieval</i> , Cambridge University Press, Updated Digital Edition, 2022.                          |
| 5                | Paul Taylor, <i>Text-to-Speech Synthesis</i> , Cambridge University Press, 2009 (standard reference for TTS).                                                                                       |
| Web References:  |                                                                                                                                                                                                     |
| 1                | <a href="https://onlinecourses.nptel.ac.in/noc26_cs45/preview?">https://onlinecourses.nptel.ac.in/noc26_cs45/preview?</a>                                                                           |
| 2                | <a href="https://www.coursera.org/specializations/natural-language-processing?">https://www.coursera.org/specializations/natural-language-processing?</a>                                           |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 80%                   |                | 20%                  |            |            |                          |
| Apply                                                       | 20%                   | 100%           | 80%                  |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C504.1      | 3    | 2    | -    | -    | -    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 2     |
| C504.2      | 3    | 3    | 2    | 2    | -    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 2     |
| C504.3      | 3    | 3    | 3    | 2    | -    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 2     |
| C504.4      | 3    | 2    | 2    | 2    | -    | -    | -    | -    | -    | -     | 2     | 2     | 3     | 2     |
| C504.5      | 3    | 3    | 2    | 3    | -    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                           | Course Name                                                                                    | Category               | Hours/Week                |   |   | C        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----------|
|                                                                                                                                                                                                                                                                                                                                                       |                                                                                                |                        | L                         | T | P |          |
| 24AD505                                                                                                                                                                                                                                                                                                                                               | BUSINESS ANALYTICS                                                                             | PE                     | 3                         | 0 | 0 | 3        |
| Regulation                                                                                                                                                                                                                                                                                                                                            | Nature of the Course                                                                           | Semester               | Data Book/Codes/Standards |   |   |          |
| 2024                                                                                                                                                                                                                                                                                                                                                  | THEORY                                                                                         | -                      | -                         |   |   |          |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                               |                                                                                                | Co-requisite Course(s) |                           |   |   |          |
| Fundamentals of Data Science and Analytics                                                                                                                                                                                                                                                                                                            |                                                                                                | -                      |                           |   |   |          |
| Course Objectives                                                                                                                                                                                                                                                                                                                                     |                                                                                                |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                     | To understand the Analytics Life Cycle.                                                        |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                     | To comprehend the process of acquiring Business Intelligence                                   |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                                     | To understand various types of analytics for Business Forecasting                              |                        |                           |   |   |          |
| 4                                                                                                                                                                                                                                                                                                                                                     | To model the supply chain management for Analytics.                                            |                        |                           |   |   |          |
| 5                                                                                                                                                                                                                                                                                                                                                     | To apply analytics for different functions of a business                                       |                        |                           |   |   |          |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                       |                                                                                                |                        |                           |   |   |          |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                               |                                                                                                |                        |                           |   |   |          |
| C505.1                                                                                                                                                                                                                                                                                                                                                | Explain the real-world business problems and model with analytical solutions.                  |                        |                           |   |   | [U]      |
| C505.2                                                                                                                                                                                                                                                                                                                                                | Outline the business processes for extracting Business Intelligence                            |                        |                           |   |   | [U]      |
| C505.3                                                                                                                                                                                                                                                                                                                                                | Apply predictive analytics for business forecasting                                            |                        |                           |   |   | [AP]     |
| C505.4                                                                                                                                                                                                                                                                                                                                                | Apply analytics for supply chain and logistics management                                      |                        |                           |   |   | [AP]     |
| C505.5                                                                                                                                                                                                                                                                                                                                                | Use analytics for marketing and sales.                                                         |                        |                           |   |   | [AP]     |
| Course Contents                                                                                                                                                                                                                                                                                                                                       |                                                                                                |                        |                           |   |   |          |
| Unit-1                                                                                                                                                                                                                                                                                                                                                | INTRODUCTION TO BUSINESS ANALYTICS                                                             |                        |                           |   |   | C01 9Hrs |
| Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration – Introduction to Real-World Business Case Studies in Analytics.                                 |                                                                                                |                        |                           |   |   |          |
| Unit-2                                                                                                                                                                                                                                                                                                                                                | BUSINESS INTELLIGENCE                                                                          |                        |                           |   |   | C02 9Hrs |
| Data Warehouses and Data Mart – Knowledge Management – Types of Decisions – Decision Making Process – Decision Support Systems – Business Intelligence – OLAP – Analytic functions – Introduction to Data Visualization Tools: Power BI and Tableau – Dashboard Creation and Business Reporting.                                                      |                                                                                                |                        |                           |   |   |          |
| Unit-3                                                                                                                                                                                                                                                                                                                                                | BUSINESS FORECASTING                                                                           |                        |                           |   |   | C03 9Hrs |
| Introduction to Business Forecasting and Predictive Analytics – Logic and Data-driven Models – Data Mining and Predictive Analysis Modeling – Machine Learning for Predictive Analytics – Time Series Forecasting Models – Trend Analysis – Moving Average and Exponential Smoothing Methods.                                                         |                                                                                                |                        |                           |   |   |          |
| Unit-4                                                                                                                                                                                                                                                                                                                                                | HR & SUPPLY CHAIN ANALYTICS                                                                    |                        |                           |   |   | C04 9Hrs |
| Human Resources – Planning and Recruitment – Training and Development – Supply chain network – Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain – Applying HR Analytics to make a prediction of the demand for hourly employees for a year – Real-world Case Studies in HR and Supply Chain Analytics. |                                                                                                |                        |                           |   |   |          |
| Unit-5                                                                                                                                                                                                                                                                                                                                                | MARKETING & SALES ANALYTICS                                                                    |                        |                           |   |   | C05 9Hrs |
| Marketing Strategy – Marketing Mix – Customer Behaviour – Selling Process – Sales Planning – Analytics Applications in Marketing and Sales – Predictive Analytics for Customer Behaviour – Customer Segmentation – Marketing and Sales Case Studies using Business Analytics Tools.                                                                   |                                                                                                |                        |                           |   |   |          |
| Total Hours                                                                                                                                                                                                                                                                                                                                           |                                                                                                |                        |                           |   |   | 45       |
| Textbooks:                                                                                                                                                                                                                                                                                                                                            |                                                                                                |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                     | James R. Evans, Business Analytics, 3rd Edition, Pearson Education, 2020.                      |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                     | R. N. Prasad and Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016.  |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                                     | Deanne Larson, Modern Business Analytics, O'Reilly, 2024.                                      |                        |                           |   |   |          |
| Reference Books:                                                                                                                                                                                                                                                                                                                                      |                                                                                                |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                     | Philip Kotler, Kevin Lane Keller, Marketing Management, 17th Edition, Pearson Education, 2025. |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                     | VSPRAO, Human Resource Management, 3rd Edition, Excel Books, 2010.                             |                        |                           |   |   |          |

|                       |                                                                                                                           |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------|
| 3                     | Amar Sahay, Business Analytics, Business Expert Press, 2019.                                                              |
| <b>WebReferences:</b> |                                                                                                                           |
| 1                     | <a href="https://onlinecourses.nptel.ac.in/noc26_cs64/preview?">https://onlinecourses.nptel.ac.in/noc26_cs64/preview?</a> |
| 2                     | <a href="https://www.ibm.com/topics/business-analytics">https://www.ibm.com/topics/business-analytics</a>                 |

**Assessment based on Continuous and End Semester Examination**

| BLOOM'S TAXONOMY LEVEL   | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|--------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
|                          | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                 |                       |                |                      | 10         | 10         | 60                       |
| Understand               | 100%                  | 50%            | 40%                  |            |            |                          |
| Apply                    |                       | 50%            | 60%                  |            |            |                          |
| Analyze                  |                       |                |                      |            |            |                          |
| Evaluate                 |                       |                |                      |            |            |                          |
| Create                   |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C505.1      | 3    | 3    | 2    | 2    | -    | -    | -    | -    | -    | 2     | 2     | 2     | 3     | 2     |
| C505.2      | 2    | 3    | 1    | 2    | -    | -    | -    | -    | -    | 2     | 2     | 3     | 3     | 2     |
| C505.3      | 2    | 3    | 2    | 2    | -    | -    | -    | -    | -    | 2     | 2     | 3     | 3     | 2     |
| C505.4      | 2    | 3    | 2    | 2    | -    | 2    | -    | -    | -    | 2     | 2     | 3     | 3     | 2     |
| C505.5      | 2    | 3    | 2    | 2    | -    | 1    | -    | -    | -    | 2     | 2     | 3     | 3     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                               | Course Name                                                                                                                                                                                                                                                             | Category               | Hours/Week                |   |   | C    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|
|                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                         |                        | L                         | T | P |      |
| 24AD506                                                                                                                                                                                                                                   | Ethics and Artificial Intelligence                                                                                                                                                                                                                                      | PE                     | 3                         | 0 | 0 | 3    |
| Regulation                                                                                                                                                                                                                                | Nature of the Course                                                                                                                                                                                                                                                    | Semester               | Data Book/Codes/Standards |   |   |      |
| 2024                                                                                                                                                                                                                                      | THEORY                                                                                                                                                                                                                                                                  |                        | -----                     |   |   |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                         | Co-requisite Course(s) |                           |   |   |      |
| Artificial Intelligence –1                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                         | -                      |                           |   |   |      |
| Course Objectives                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                         |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                         | Study the morality and ethics in AI                                                                                                                                                                                                                                     |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                         | Learn about the Ethical initiatives in the field of artificial intelligence                                                                                                                                                                                             |                        |                           |   |   |      |
| 3                                                                                                                                                                                                                                         | Study about AI standards and Regulations                                                                                                                                                                                                                                |                        |                           |   |   |      |
| 4                                                                                                                                                                                                                                         | Study about social and ethical issues of Robot Ethics                                                                                                                                                                                                                   |                        |                           |   |   |      |
| 5                                                                                                                                                                                                                                         | Study about AI and Ethics- challenges and opportunities                                                                                                                                                                                                                 |                        |                           |   |   |      |
| Course Outcomes                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                         |                        |                           |   |   |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                   |                                                                                                                                                                                                                                                                         |                        |                           |   |   |      |
| C506.1                                                                                                                                                                                                                                    | Understand the concepts of morality, ethics, and ethical harms in Artificial Intelligence.                                                                                                                                                                              |                        |                           |   |   | [U]  |
| C506.2                                                                                                                                                                                                                                    | Apply knowledge of real-time AI applications to identify and address associated ethical issues and implementation challenges in practical scenarios.                                                                                                                    |                        |                           |   |   | [AP] |
| C506.3                                                                                                                                                                                                                                    | Examine AI standards and regulations                                                                                                                                                                                                                                    |                        |                           |   |   | [AP] |
| C506.4                                                                                                                                                                                                                                    | Illustrate roboethics including AI agents and the safe design of autonomous and semi-autonomous systems.                                                                                                                                                                |                        |                           |   |   | [AP] |
| C506.5                                                                                                                                                                                                                                    | Use the principles of roboethics, morality, and professional responsibilities in AI development and deployment.                                                                                                                                                         |                        |                           |   |   | [AP] |
| Course Contents                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                         |                        |                           |   |   |      |
| Unit-1                                                                                                                                                                                                                                    | INTRODUCTION TO ETHICAL INITIATIVES IN AI                                                                                                                                                                                                                               |                        |                           |   |   | 9    |
| Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust                                                                  |                                                                                                                                                                                                                                                                         |                        |                           |   |   |      |
| Unit-2                                                                                                                                                                                                                                    | ETHICAL HARMS AND APPLICATIONS                                                                                                                                                                                                                                          |                        |                           |   |   | 9    |
| International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles, Warfare and weaponization.                                                                                               |                                                                                                                                                                                                                                                                         |                        |                           |   |   |      |
| Unit-3                                                                                                                                                                                                                                    | AI STANDARDS AND REGULATION                                                                                                                                                                                                                                             |                        |                           |   |   | 9    |
| Model Process for Addressing Ethical Concerns During System Design- Transparency of Autonomous Systems- Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems |                                                                                                                                                                                                                                                                         |                        |                           |   |   |      |
| Unit-4                                                                                                                                                                                                                                    | ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS                                                                                                                                                                                                                  |                        |                           |   |   | 9    |
| Robot-Roboethics- Ethics and Morality- Moral Theories- Ethics in Science and Technology- Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Roboethics Taxonomy.                      |                                                                                                                                                                                                                                                                         |                        |                           |   |   |      |
| Unit-5                                                                                                                                                                                                                                    | AI AND ETHICS- CHALLENGES AND OPPORTUNITIES                                                                                                                                                                                                                             |                        |                           |   |   | 9    |
| Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI. |                                                                                                                                                                                                                                                                         |                        |                           |   |   |      |
| Total Hours                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                         |                        |                           |   |   | 45   |
| Textbooks:                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                         |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                         | y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield , "The ethics of artificial intelligence: Issues and initiatives", EPRS  European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452-March 2020 |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                         | Patrick Lin, Keith Abney, George A Bekey, " Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014.                                                                                                                                |                        |                           |   |   |      |
| Reference Books:                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                         |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                         | Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017                                                                                                                  |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                         | Mark Coeckelbergh, " AI Ethics", The MIT Press Essential Knowledge series, April 2020                                                                                                                                                                                   |                        |                           |   |   |      |

| <b>WebReferences:</b> |                                                                                                                                                                                                                                                         |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                     | <a href="https://sci-hub.mkssa.top/10.1007/978-3-540-30301-5_65">https://sci-hub.mkssa.top/10.1007/978-3-540-30301-5_65</a>                                                                                                                             |
| 2                     | <a href="https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteen-challenges-and-opportunities/">https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteen-challenges-and-opportunities/</a> |
| 3                     | <a href="https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/">https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/</a>                                                         |
| 4                     | <a href="https://sci-hub.mkssa.top/10.1159/000492428">https://sci-hub.mkssa.top/10.1159/000492428</a>                                                                                                                                                   |

| <b>Assessment based on Continuous and End Semester Examination</b> |                              |                           |                                 |                   |                   |                                 |
|--------------------------------------------------------------------|------------------------------|---------------------------|---------------------------------|-------------------|-------------------|---------------------------------|
| <b>Bloom's Level</b>                                               | <b>Continuous Assessment</b> |                           |                                 | <b>Assignment</b> | <b>Attendance</b> | <b>End Semester Examination</b> |
|                                                                    | <b>CIA1<br/>(6 Marks)</b>    | <b>CIA2<br/>(6 Marks)</b> | <b>Model Exam<br/>(8 Marks)</b> |                   |                   |                                 |
| Remember                                                           |                              |                           |                                 | (10 Marks)        | (10 Marks)        | (60 Marks)                      |
| Understand                                                         | 80%                          |                           | 20%                             |                   |                   |                                 |
| Apply                                                              | 20%                          | 100%                      | 80%                             |                   |                   |                                 |
| Analyze                                                            |                              |                           |                                 |                   |                   |                                 |
| Evaluate                                                           |                              |                           |                                 |                   |                   |                                 |
| Create                                                             |                              |                           |                                 |                   |                   |                                 |
| <b>Total(100 Marks)</b>                                            | <b>6</b>                     | <b>6</b>                  | <b>8</b>                        | <b>10</b>         | <b>10</b>         | <b>60</b>                       |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| <b>COs/<br/>POs</b> | <b>PO 1</b> | <b>PO 2</b> | <b>PO 3</b> | <b>PO 4</b> | <b>PO 5</b> | <b>PO 6</b> | <b>PO 7</b> | <b>PO 8</b> | <b>PO 9</b> | <b>PO 10</b> | <b>PO 11</b> | <b>PSO 1</b> | <b>PSO 2</b> | <b>PSO 3</b> |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|
| C506.1              | 3           | 2           | 3           | 3           | -           | -           | -           | -           | -           | -            | 1            | 3            | 2            | 2            |
| C506.2              | 2           | 1           | 1           | 2           | -           | -           | -           | -           | -           | -            | 1            | 3            | 3            | 2            |
| C506.3              | 2           | 3           | 1           | 1           | -           | -           | -           | -           | -           | -            | 1            | 3            | 2            | 2            |
| C506.4              | 3           | 1           | 3           | 3           | -           | -           | -           | -           | -           | -            | 3            | 2            | 2            | 3            |
| C506.5              | 3           | 1           | 1           | 3           | -           | -           | -           | -           | -           | -            | 3            | 2            | 3            | 3            |

# **VERTICALII FULLSTACKDEVELOPMENT**

| Course Code                                                                                                                                                                                                                                                                                                  | CourseName                                                                                                                   | Category              | Hours/Week               |   |   | C    |      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|---|------|------|
|                                                                                                                                                                                                                                                                                                              |                                                                                                                              |                       | L                        | T | P |      |      |
| 24CC501                                                                                                                                                                                                                                                                                                      | WEBTECHNOLOGY                                                                                                                | PE                    | 3                        | 0 | 0 | 3    |      |
| Regulation                                                                                                                                                                                                                                                                                                   | NatureoftheCourse                                                                                                            | Semester              | DataBook/Codes/Standards |   |   |      |      |
| 2024                                                                                                                                                                                                                                                                                                         | THEORY                                                                                                                       | -                     | -                        |   |   |      |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                       |                                                                                                                              | Co-requisiteCourse(s) |                          |   |   |      |      |
| -                                                                                                                                                                                                                                                                                                            |                                                                                                                              | -                     |                          |   |   |      |      |
| CourseObjectives                                                                                                                                                                                                                                                                                             |                                                                                                                              |                       |                          |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                            | To understand the fundamentals ofwebtechnologies and develop basic web pages using HTMLand CSS.                              |                       |                          |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                            | To learn client-side scripting using JavaScript for creating dynamic web pages with validationand event handling mechanisms. |                       |                          |   |   |      |      |
| 3                                                                                                                                                                                                                                                                                                            | To understand server-side web programming concepts and developweb applications usingServlets and JSP.                        |                       |                          |   |   |      |      |
| 4                                                                                                                                                                                                                                                                                                            | To learn PHP programming andXML technologies for creating dynamic web pages andrepresenting structured data.                 |                       |                          |   |   |      |      |
| 5                                                                                                                                                                                                                                                                                                            | To develop interactive web applications using modern web application frameworks andtechnologies.                             |                       |                          |   |   |      |      |
| CourseOutcomes                                                                                                                                                                                                                                                                                               |                                                                                                                              |                       |                          |   |   |      |      |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                               |                                                                                                                              |                       |                          |   |   |      |      |
| CC501.1                                                                                                                                                                                                                                                                                                      | Understand basic web pages using HTML and CSS fundamental web design concepts.                                               |                       |                          |   |   | [U]  |      |
| CC501.2                                                                                                                                                                                                                                                                                                      | Build dynamic web pages using JavaScript withvalidationtechniques and differentevent handling mechanisms.                    |                       |                          |   |   | [AP] |      |
| CC501.3                                                                                                                                                                                                                                                                                                      | Develop server-sideweb applications using Servlets and JSP.                                                                  |                       |                          |   |   | [AP] |      |
| CC501.4                                                                                                                                                                                                                                                                                                      | Construct simple web pages using PHP and represent data using XML technologies.                                              |                       |                          |   |   | [AP] |      |
| CC501.5                                                                                                                                                                                                                                                                                                      | Develop interactiveweb applications using modern web application frameworks and tools.                                       |                       |                          |   |   | [AP] |      |
| CourseContents                                                                                                                                                                                                                                                                                               |                                                                                                                              |                       |                          |   |   |      |      |
| Unit-1                                                                                                                                                                                                                                                                                                       | WEBESSENTIALS                                                                                                                |                       |                          |   |   | C01  | 9Hrs |
| Evolutionofweb -Webarchitecture - HTML5: Texttags, Graphics, Formelements, Semantictags - CSS3: Selectors,Backgrounds and borders, Text effects, Cascadingandinheritanceof style properties,BoxModel,Positioning-Introductionto responsive design-Bootstrap: Containers, Grids, Typography, Flex, and Forms. |                                                                                                                              |                       |                          |   |   |      |      |
| Unit-2                                                                                                                                                                                                                                                                                                       | CLIENTSIDEPROGRAMMING                                                                                                        |                       |                          |   |   | C02  | 9Hrs |
| JavaScript: AnintroductiontoJavaScript-JavaScriptDOMModel-ExceptionHandling-Validation-Built-inobjects-EventHandling- DHTMLwithJavaScript- JSONintroduction - Syntax - Function -Files.                                                                                                                      |                                                                                                                              |                       |                          |   |   |      |      |
| Unit-3                                                                                                                                                                                                                                                                                                       | SERVERSIDEPROGRAMMING                                                                                                        |                       |                          |   |   | C03  | 9Hrs |
| Webservers - IIS(XAMPP,LAMPP) andTomcatServers ,Servlets:JavaServletArchitecture-ServletLifeCycle-Form GET and POST actions- Session Handling- Understanding Cookies- Data Base Connectivity: JDBC.                                                                                                          |                                                                                                                              |                       |                          |   |   |      |      |
| Unit-4                                                                                                                                                                                                                                                                                                       | PHPandXML                                                                                                                    |                       |                          |   |   | C04  | 9Hrs |
| Anintroductionto PHP: PHP- Using PHP-Variables- Program control- Built-in functions- Form -Validation. XML: Basic XML- Document Type Definition- XML Schema, XML Parsers and Validation,XSL                                                                                                                  |                                                                                                                              |                       |                          |   |   |      |      |
| Unit-5                                                                                                                                                                                                                                                                                                       | WEBAPPLICATIONANDANGULARJS                                                                                                   |                       |                          |   |   | C05  | 9Hrs |
| Web applications- Webapplicationframeworks:MVCframework-AngularJS:Introduction, Data binding,Directives,Modules,Scopes,Controllers,Expressions,Filters,Events,Form-SinglePageApplication-MultipleViews and Routing - Service.                                                                                |                                                                                                                              |                       |                          |   |   |      |      |
| TotalHours                                                                                                                                                                                                                                                                                                   |                                                                                                                              |                       |                          |   |   | 45   |      |
| Textbooks:                                                                                                                                                                                                                                                                                                   |                                                                                                                              |                       |                          |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                            | BradDayley, BrendanDayley, CalebDayley, "Node.js, MongoDBandAngularJSWeb                                                     |                       |                          |   |   |      |      |

|                        |                                                                                                                                                                                                                        |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | Development", 2017, 2ndEdition, AddisonWesley- Oreilly, USA.                                                                                                                                                           |
| 2                      | JessicaMinnick, Responsive, "WebDesignwithHTML 5 &CSS, CengageLearning",2020, 9thEdition.                                                                                                                              |
| 3                      | DeitelandDeitelandNieto, InternetandWorldWideWeb - HowtoProgram, PrenticeHall, 5thEdition, 2011.                                                                                                                       |
| <b>ReferenceBooks:</b> |                                                                                                                                                                                                                        |
| 1                      | Angular 6 forEnterprise-ReadyWebApplications, DoguhanUluca, 1stedition, Packt Publishing                                                                                                                               |
| 2                      | StephenWynkoopandJohnBurke "RunningaPerfectWebsite", QUE, 2ndEdition,1999.                                                                                                                                             |
| 3                      | ChrisBates, WebProgramming – BuildingIntranet Applications, 3rdEdition, Wiley Publications, 2009.                                                                                                                      |
| 4                      | GopalanN.P. andAkilandeswariJ., "WebTechnology", PrenticeHallofIndia, 2011.                                                                                                                                            |
| <b>WebReferences:</b>  |                                                                                                                                                                                                                        |
| 1                      | <a href="https://nptel.ac.in/courses/106105084-web-architecture,HTTP,web-protocols,and-internetfundamentals">https://nptel.ac.in/courses/106105084-web-architecture, HTTP, web protocols, and internetfundamentals</a> |
| 2                      | <a href="https://developer.mozilla.org-documentation-for-HTML,CSS,JavaScript,and-webAPIs">https://developer.mozilla.org- documentation for HTML, CSS, JavaScript, and webAPIs</a>                                      |

| AssessmentbasedonContinuousandEndSemesterExamination |                      |                  |                           |            |            |                                |
|------------------------------------------------------|----------------------|------------------|---------------------------|------------|------------|--------------------------------|
| BLOOM'S<br>TAXONOMY<br>LEVEL                         | CONTINUOUSASSESSMENT |                  |                           | ASSIGNMENT | ATTENDANCE | END<br>SEMESTER<br>EXAMINATION |
|                                                      | CIA1<br>(6Marks)     | CIA2<br>(6Marks) | Model<br>Exam<br>(8Marks) | (10Marks)  | (10Marks)  | (60Marks)                      |
| Remember                                             |                      |                  |                           | 10         | 10         | 60                             |
| Understand                                           | 80                   |                  | 20                        |            |            |                                |
| Apply                                                | 20                   | 100              | 80                        |            |            |                                |
| Analyze                                              |                      |                  |                           |            |            |                                |
| Evaluate                                             |                      |                  |                           |            |            |                                |
| Create                                               |                      |                  |                           |            |            |                                |
| <b>Total<br/>(100Marks)</b>                          | <b>6</b>             | <b>6</b>         | <b>8</b>                  | <b>10</b>  | <b>10</b>  | <b>60</b>                      |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PSO<br>2 | PSO<br>3 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|
| CC501.1     | 3       | 2       | 1       | 1       | 2       | -       | -       | -       | -       | -        | 1        | 1        | 2        | 2        |
| CC501.2     | 3       | 2       | 1       | 1       | 3       | -       | -       | -       | -       | -        | 1        | 1        | 2        | 3        |
| CC501.3     | 3       | 2       | 2       | 1       | 3       | -       | -       | -       | -       | -        | 1        | 2        | 2        | 3        |
| CC501.4     | 2       | 2       | 1       | 1       | 2       | -       | -       | -       | -       | -        | 1        | 1        | 2        | 2        |
| CC501.5     | 2       | 2       | 3       | 1       | 3       | -       | -       | -       | -       | -        | 1        | 2        | 2        | 3        |

1-low, 2-medium, 3-high, '-' - no correlation

| Course Code                                                                                                                                                                                                                                                                                      | CourseName                                                                                                                                                                     | Category               | Hours/Week               |   |            | C    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------|---|------------|------|
|                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                |                        | L                        | T | P          |      |
| 24CC502                                                                                                                                                                                                                                                                                          | APPDEVELOPMENT                                                                                                                                                                 | PE                     | 3                        | 0 | 0          | 3    |
| Regulation                                                                                                                                                                                                                                                                                       | NatureoftheCourse                                                                                                                                                              | Semester               | DataBook/Codes/Standards |   |            |      |
| 2024                                                                                                                                                                                                                                                                                             | THEORY                                                                                                                                                                         | -                      | -                        |   |            |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                           |                                                                                                                                                                                | Co- requisiteCourse(s) |                          |   |            |      |
| -                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                | --                     |                          |   |            |      |
| CourseObjectives                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                |                        |                          |   |            |      |
| 1                                                                                                                                                                                                                                                                                                | Tounderstand Fundamentals ofMobile andWebApplications                                                                                                                          |                        |                          |   |            |      |
| 2                                                                                                                                                                                                                                                                                                | To develop NativeApplications                                                                                                                                                  |                        |                          |   |            |      |
| 3                                                                                                                                                                                                                                                                                                | To build HybridApplications                                                                                                                                                    |                        |                          |   |            |      |
| 4                                                                                                                                                                                                                                                                                                | To implement Cross-PlatformApplications                                                                                                                                        |                        |                          |   |            |      |
| 5                                                                                                                                                                                                                                                                                                | To evaluate Non-Functional Characteristics ofApp Frameworks                                                                                                                    |                        |                          |   |            |      |
| CourseOutcomes                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                |                        |                          |   |            |      |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                   |                                                                                                                                                                                |                        |                          |   |            |      |
| CC502.1                                                                                                                                                                                                                                                                                          | Explain the fundamentals of mobile and web application development including native,hybrid, cross-platform, progressive web applications and responsive web design.            |                        |                          |   |            | [U]  |
| CC502.2                                                                                                                                                                                                                                                                                          | Develop basic native mobile applications using Java/Kotlinfor Android and Swift/Objective-CforiOS.                                                                             |                        |                          |   |            | [AP] |
| CC502.3                                                                                                                                                                                                                                                                                          | Build hybrid mobile applications using frameworks such as Ionic andApache Cordova.                                                                                             |                        |                          |   |            | [AP] |
| CC502.4                                                                                                                                                                                                                                                                                          | Implement cross-platform applications using frameworks like React Native, Flutter, and XamarinwithconceptsofJSX, state, andprops.                                              |                        |                          |   |            | [AP] |
| CC502.5                                                                                                                                                                                                                                                                                          | Applythenon-functionalcharacteristicssuchasbuildperformance,debuggingcapability,maintainability,UI/UX,andreusabilitytocompareandselectappropriatemobile application frameworks |                        |                          |   |            | [AP] |
| CourseContents                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                |                        |                          |   |            |      |
| Unit-1                                                                                                                                                                                                                                                                                           | FUNDAMENTALSOFGMOBILE&WEBAPPLICATIONDEVELOPMENT                                                                                                                                |                        |                          |   | C01        | 9Hrs |
| Basics ofWeb and Mobile application development, Android architecture and Flutter framework overview,Native App, HybridApp, Cross-platformApp, WhatisProgressiveWebApp, ResponsiveWebdesign.                                                                                                     |                                                                                                                                                                                |                        |                          |   |            |      |
| Unit-2                                                                                                                                                                                                                                                                                           | NATIVEAPPDEVELOPMENTUSINGJAVA                                                                                                                                                  |                        |                          |   | C02        | 9Hrs |
| NativeWebApp, BenefitsofNativeApp, ScenariostocreateNativeApp, ToolsforcreatingNative ,App, ConsofNativeApp,PopularNativeAppDevelopmentFrameworks, Java&KotlinforAndroid,Swift&Objective-Cfor iOS, Basics ofReact Native, Native Components, JSX, State, Props.                                  |                                                                                                                                                                                |                        |                          |   |            |      |
| Unit-3                                                                                                                                                                                                                                                                                           | HYBRIDAPPDEVELOPMENT                                                                                                                                                           |                        |                          |   | C03        | 9Hrs |
| HybridWebApp, BenefitsofHybridApp, CriteriaforcreatingNativeApp, Toolsforcreating,HybridApp, Consof HybridApp, Popular HybridApp Development Frameworks, Ionic,Apache Cordova.                                                                                                                   |                                                                                                                                                                                |                        |                          |   |            |      |
| Unit-4                                                                                                                                                                                                                                                                                           | CROSS-PLATFORMAPPDEVELOPMENTUSINGREACT-NATIVE                                                                                                                                  |                        |                          |   | C04        | 9Hrs |
| WhatisCross-platformApp, BenefitsofCross-platformApp, CriteriaforcreatingCross-platformApp, ToolsforcreatingCross-platformApp, ConsofCross-platformApp, PopularCrossplatformAppDevelopment Frameworks, Flutter, Xamarin, React-Native, BasicsofReactNative, NativeComponents, JSX, State, Props. |                                                                                                                                                                                |                        |                          |   |            |      |
| Unit-5                                                                                                                                                                                                                                                                                           | NON-FUNCTIONALCHARACTERISTICSOFAPPFRAMEWORKS                                                                                                                                   |                        |                          |   | C05        | 9Hrs |
| Comparison ofdifferentApp frameworks, Build Performance,App Performance, Debugging capabilities, Timeto Market, Maintainability, EaseofDevelopment, UI/UX, Reusability .                                                                                                                         |                                                                                                                                                                                |                        |                          |   |            |      |
|                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                |                        |                          |   | TotalHours | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                |                        |                          |   |            |      |
| 1                                                                                                                                                                                                                                                                                                | HeadFirstAndroidDevelopment, DawnGriffiths, O'Reilly, 1stedition                                                                                                               |                        |                          |   |            |      |
| 2                                                                                                                                                                                                                                                                                                | ApacheCordovainAction, RaymondK. Camden, Manning. 2015                                                                                                                         |                        |                          |   |            |      |
| 3                                                                                                                                                                                                                                                                                                | BeginningFlutter: AHandsOnGuidetoAppDevelopment, MarcoL. Napoli , ISBN: 978-1-119-55082-2, October 2019                                                                        |                        |                          |   |            |      |
| ReferenceBooks:                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                |                        |                          |   |            |      |
| 1                                                                                                                                                                                                                                                                                                | AndroidProgrammingforBeginners, JohnHorton, PacktPublishing, 2ndEdition                                                                                                        |                        |                          |   |            |      |
| 2                                                                                                                                                                                                                                                                                                | Building Cross-Platform Mobile and WebApps for Engineers and Scientists: AnActiveLearning Approach, Pawan Lingras, Matt Triff, Rucha Lingras                                   |                        |                          |   |            |      |
| 3                                                                                                                                                                                                                                                                                                | Beginning AppDevelopment with Flutter>Create Cross-PlatformMobile Apps1sted.Edition, by                                                                                        |                        |                          |   |            |      |

|                       |                                                                                                                                                                                 |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | RapPayne, 2019, Publisher(s): Apress, ISBN: 978-1484251805                                                                                                                      |
| 4                     | ProgrammingAndroidwithKotlin,byPierre-OlivierLaurence,AmandaHinchman-Dominguez, MikeDunn, G. BlakeMeike, December 2021, Publisher(s): O'Reilly Media, Inc., ISBN: 9781492063001 |
| <b>WebReferences:</b> |                                                                                                                                                                                 |
| 1                     | Android Developer Documentation: <a href="https://developer.android.com/docs">https://developer.android.com/docs</a>                                                            |
| 2                     | Flutter Documentation: <a href="https://flutter.dev/docs">https://flutter.dev/docs</a>                                                                                          |

| <b>AssessmentbasedonContinuousandEndSemesterExamination</b> |                             |                          |                               |                        |                   |                                         |
|-------------------------------------------------------------|-----------------------------|--------------------------|-------------------------------|------------------------|-------------------|-----------------------------------------|
| <b>BLOOM'S<br/>TAXONOMY<br/>LEVEL</b>                       | <b>CONTINUOUSASSESSMENT</b> |                          |                               | <b>ASSIGNMEN<br/>T</b> | <b>ATTENDANCE</b> | <b>END<br/>SEMESTER<br/>EXAMINATION</b> |
|                                                             | <b>CIA1<br/>(6Marks)</b>    | <b>CIA2<br/>(6Marks)</b> | <b>ModelExam<br/>(8Marks)</b> | <b>(10Marks)</b>       | <b>(10Marks)</b>  | <b>(60Marks)</b>                        |
| Remember                                                    |                             |                          |                               | <b>10</b>              | <b>10</b>         | <b>60</b>                               |
| Understand                                                  | 80                          |                          | 20                            |                        |                   |                                         |
| Apply                                                       | 20                          | 100                      | 80                            |                        |                   |                                         |
| Analyze                                                     |                             |                          |                               |                        |                   |                                         |
| Evaluate                                                    |                             |                          |                               |                        |                   |                                         |
| Create                                                      |                             |                          |                               |                        |                   |                                         |
| <b>Total<br/>(100Marks)</b>                                 | <b>6</b>                    | <b>6</b>                 | <b>8</b>                      | <b>10</b>              | <b>10</b>         | <b>60</b>                               |

- CIA1, CIA2 and ModelExam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| <b>COs/<br/>POs</b> | <b>PO<br/>1</b> | <b>PO<br/>2</b> | <b>PO<br/>3</b> | <b>PO<br/>4</b> | <b>PO<br/>5</b> | <b>PO<br/>6</b> | <b>PO<br/>7</b> | <b>PO<br/>8</b> | <b>PO<br/>9</b> | <b>PO<br/>10</b> | <b>PO<br/>11</b> | <b>PSO<br/>1</b> | <b>PSO<br/>2</b> | <b>PSO<br/>3</b> |
|---------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|------------------|
| CC502.1             | 3               | 2               | 1               | 1               | 2               | -               | -               | -               | -               | -                | 1                | 1                | 2                | 2                |
| CC502.2             | 3               | 2               | 2               | 1               | 3               | -               | -               | -               | -               | -                | 1                | 2                | 2                | 3                |
| CC502.3             | 2               | 2               | 2               | 1               | 3               | -               | -               | -               | -               | -                | 1                | 1                | 2                | 3                |
| CC502.4             | 2               | 2               | 3               | 1               | 3               | -               | -               | -               | -               | -                | 1                | 2                | 2                | 3                |
| CC502.5             | 2               | 2               | 2               | 1               | 2               | -               | -               | -               | -               | -                | 2                | 2                | 2                | 2                |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CourseName                                                                                                             | Category               | Hours/Week                |   |     | C    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-----|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                        |                        | L                         | T | P   |      |
| 24CC503                                                                                                                                                                                                                                                                                                                                                                                                                                                     | SOFTWARE TESTING AND AUTOMATION                                                                                        | PE                     | 3                         | 0 | 0   | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Nature of the Course                                                                                                   | Semester               | Data Book/Codes/Standards |   |     |      |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                        | THEORY                                                                                                                 | -                      | -----                     |   |     |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                        | Co-requisite Course(s) |                           |   |     |      |
| -                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                        | -                      |                           |   |     |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                        |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                           | To understand the basics of software testing.                                                                          |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                           | To learn how to do testing, plan and design.                                                                           |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                           | To learn how to execute the test cases.                                                                                |                        |                           |   |     |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                           | To focus on wide aspects of testing and understanding multiple facets of testing.                                      |                        |                           |   |     |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                           | To get an insight about the test automation and tools used for test automation.                                        |                        |                           |   |     |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                        |                        |                           |   |     |      |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                        |                        |                           |   |     |      |
| CC503.1                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Understand the basic concepts of software testing and the need for software testing.                                   |                        |                           |   |     | [U]  |
| CC503.2                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply concepts of test planning and test design for the software systems.                                              |                        |                           |   |     | [AP] |
| CC503.3                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply effective test cases that can uncover critical defects in the application.                                       |                        |                           |   |     | [AP] |
| CC503.4                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply the software systems using advanced testing methods.                                                             |                        |                           |   |     | [AP] |
| CC503.5                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Automate the software testing using Selenium and TestNG.                                                               |                        |                           |   |     | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                        |                        |                           |   |     |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                      | INTRODUCTION                                                                                                           |                        |                           |   | C01 | 9Hrs |
| Need of software test- Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults, Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing. Test Strategies: Top-Down Testing, Bottom-Up Testing, Thread testing, Stress testing, Back-to-back testing; |                                                                                                                        |                        |                           |   |     |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                                                      | TEST PLANNING AND DESIGN                                                                                               |                        |                           |   | C02 | 9Hrs |
| TEST PLANNING: The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics. TEST DESIGN: Test Objective Identification, Test Design Factors & Requirements, Modeling a Test Design Process,                                                                                                    |                                                                                                                        |                        |                           |   |     |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                                                      | TEST EXECUTION                                                                                                         |                        |                           |   | C03 | 9Hrs |
| Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.                                                                                                                                                                 |                                                                                                                        |                        |                           |   |     |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ADVANCED TESTING CONCEPTS                                                                                              |                        |                           |   | C04 | 9Hrs |
| Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications.                                                                                                                                                                |                                                                                                                        |                        |                           |   |     |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                                                      | TEST AUTOMATION AND TOOLS                                                                                              |                        |                           |   | C05 | 9Hrs |
| Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web120 Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports                                                                                                                                 |                                                                                                                        |                        |                           |   |     |      |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                        |                        |                           |   | 45  |      |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                        |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Yogesh Singh, "Software Testing", Cambridge University Press, 2012.                                                    |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018.                        |                        |                           |   |     |      |
| Reference Books:                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                        |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc. |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Fourth Edition, 2014, Taylor & Francis Group.             |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Carl Cocchiario, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.                             |                        |                           |   |     |      |

|                       |                                                                                                                                                                             |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4                     | ElfriedeDustin,ThomGarrett,BernieGaurf,ImplementingAutomatedSoftwareTesting,2009, PearsonEducation, Inc.                                                                    |
| <b>WebReferences:</b> |                                                                                                                                                                             |
| 1                     | <a href="https://onlinecourses.nptel.ac.in/noc25_cs66/preview">https://onlinecourses.nptel.ac.in/noc25_cs66/preview</a>                                                     |
| 2                     | <a href="https://www.udemy.com/course/automation-testing-online-course-with-certificate">https://www.udemy.com/course/automation-testing-online-course-with-certificate</a> |

| AssessmentbasedonContinuousandEndSemesterExamination |                      |                  |                        |                         |                         |                                       |
|------------------------------------------------------|----------------------|------------------|------------------------|-------------------------|-------------------------|---------------------------------------|
| BLOOM'S LEVEL                                        | CONTINUOUSASSESSMENT |                  |                        | ASSIGNMENT<br>(10Marks) | ATTENDANCE<br>(10Marks) | END SEMESTER EXAMINATION<br>(60Marks) |
|                                                      | CIA1<br>(6MARKS)     | CIA2<br>(6MARKS) | MODEL EXAM<br>(8MARKS) |                         |                         |                                       |
| Remember                                             |                      |                  |                        | 10                      | 10                      | 60                                    |
| Understand                                           | 80                   |                  | 20                     |                         |                         |                                       |
| Apply                                                | 20                   | 100              | 80                     |                         |                         |                                       |
| Analyze                                              |                      |                  |                        |                         |                         |                                       |
| Evaluate                                             |                      |                  |                        |                         |                         |                                       |
| Create                                               |                      |                  |                        |                         |                         |                                       |
| <b>Total(100 Marks)</b>                              | <b>6</b>             | <b>6</b>         | <b>8</b>               | <b>10</b>               | <b>10</b>               | <b>60</b>                             |

- CIA1, CIA 2 andModelExamwillbeconductedfor 50, 50 and 100 marks.Itshallbesubsequentlyconvertedto 6, 6 and 8 marksrespectively.
- TheAssignment marks will be computed based on Assignment I, Assignment II and Assignment III marks convertedto10 Marks.
- BTLmarksplitupmayvarybasedonthenatureofthesubject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| CC503.1     | 3    | 3    | 2    | 1    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 2     | 3     |
| CC503.2     | 2    | 3    | 1    | 1    | 1    | -    | -    | -    | -    | -     | 2     | 1     | 2     | 3     |
| CC503.3     | 2    | 2    | 1    | 3    | 1    | -    | -    | -    | -    | -     | 2     | 2     | 3     | 2     |
| CC503.4     | 2    | 1    | 3    | 2    | 1    | -    | -    | -    | -    | -     | 3     | 3     | 1     | 2     |
| CC503.5     | 2    | 2    | 1    | 3    | 1    | -    | -    | -    | -    | -     | 1     | 2     | 1     | 3     |

1-low,2-medium,3-high,'-'-nocorrelation

| Course Code                                                                                                                                                                                                                                                                                                                                            | CourseName                                                                                                                                    | Category               | Hours/Week               |   |   | C    |      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------|---|---|------|------|
|                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                               |                        | L                        | T | P |      |      |
| 24CC504                                                                                                                                                                                                                                                                                                                                                | WEBAPPLICATIONSECURITY                                                                                                                        | PE                     | 3                        | 0 | 0 | 3    |      |
| Regulation                                                                                                                                                                                                                                                                                                                                             | NatureoftheCourse                                                                                                                             | Semester               | DataBook/Codes/Standards |   |   |      |      |
| 2024                                                                                                                                                                                                                                                                                                                                                   | THEORY                                                                                                                                        | -                      | -                        |   |   |      |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                               | Co- requisiteCourse(s) |                          |   |   |      |      |
| -                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                               | -                      |                          |   |   |      |      |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                               |                        |                          |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                                                      | To provide a strong foundation in the fundamental concepts and principles ofWeb ApplicationSecurity.                                          |                        |                          |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                                                      | Toenablelearnerstounderstandsecuredesignpracticesandtheimplementationofsecuritymec hanisms during web application development and deployment. |                        |                          |   |   |      |      |
| 3                                                                                                                                                                                                                                                                                                                                                      | Toimpartknowledge on designingand implementing secureApplication Programming Interfaces(APIs).                                                |                        |                          |   |   |      |      |
| 4                                                                                                                                                                                                                                                                                                                                                      | Tointroducethemethodologies,tools,andtechniquesusedinvulnerabilityassessmentandpenet ration testing.                                          |                        |                          |   |   |      |      |
| 5                                                                                                                                                                                                                                                                                                                                                      | Toacquire basic insight into ethical hacking techniques and commonly used security tools.                                                     |                        |                          |   |   |      |      |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                               |                        |                          |   |   |      |      |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                                                                         |                                                                                                                                               |                        |                          |   |   |      |      |
| CC504.1                                                                                                                                                                                                                                                                                                                                                | Understanding the fundamental concepts and principles ofweb application security.                                                             |                        |                          |   |   | [U]  |      |
| CC504.2                                                                                                                                                                                                                                                                                                                                                | Applysecuredesign and development practices in building anddeploying webapplications.                                                         |                        |                          |   |   | [AP] |      |
| CC504.3                                                                                                                                                                                                                                                                                                                                                | Develop and implement secure APIs by incorporating appropriate authentication andauthorization mechanisms.                                    |                        |                          |   |   | [AP] |      |
| CC504.4                                                                                                                                                                                                                                                                                                                                                | Apply vulnerability assessmentandpenetrationtestingtoolstodetectsecurityweaknesses in web applications.                                       |                        |                          |   |   | [AP] |      |
| CC504.5                                                                                                                                                                                                                                                                                                                                                | Demonstrate the use of securitytoolsand ethicalhacking techniquesto detectvulnerabilities and apply corrective actions.                       |                        |                          |   |   | [AP] |      |
| CourseContents                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                               |                        |                          |   |   |      |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                 | FUNDAMENTALSOFWEBAPPLICATIONSECURITY                                                                                                          |                        |                          |   |   | C01  | 9Hrs |
| ThehistoryofSoftwareSecurity- RecognizingWebApplicationSecurityThreats,WebApplicationSecurity,AuthenticationandAuthorization,Secure Socketlayer,TransportlayerSecurity,SessionManagement -Input Validation                                                                                                                                             |                                                                                                                                               |                        |                          |   |   |      |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                 | SECUREDEVELOPMENTANDDEPLOYMENT                                                                                                                |                        |                          |   |   | C02  | 9Hrs |
| WebApplicationsSecurity -SecurityTesting, Security IncidentResponsePlanning,TheMicrosoft SecurityDevelopmentLifecycle(SDL),OWASPComprehensiveLightweight ApplicationSecurityProcess(CLASP),TheSoftwareAssurance Maturity Model (SAMM)                                                                                                                  |                                                                                                                                               |                        |                          |   |   |      |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                 | SECUREAPIDEVELOPMENT                                                                                                                          |                        |                          |   |   | C03  | 9Hrs |
| APISecurity- SessionCookies, TokenBasedAuthentication, SecuringNatterAPIs:Addressingthreatswith Security Controls, Rate Limiting for Availability, Encryption, Audit logging,Securing service-to-service APIs: API Keys, OAuth2, SecuringMicroserviceAPIs: Service Mesh, LockingDownNetworkConnections, Securing IncomingRequests.                     |                                                                                                                                               |                        |                          |   |   |      |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                 | VULNERABILITYASSESSMENTANDPENETRATIONTESTING                                                                                                  |                        |                          |   |   | C04  | 9Hrs |
| Vulnerability AssessmentLifecycle, Vulnerability AssessmentTools:Cloud -based vulnerabilityscanners,Host-basedvulnerabilityscanners,Network- basedvulnerabilityscanners,Databasebasedvulnerabilityscanners,TypesofPenetrationTests:ExternalTestin g,WebApplicationTesting,InternalPenetrationTesting,SSIDor WirelessTesting, MobileApplicationTesting. |                                                                                                                                               |                        |                          |   |   |      |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                 | HACKINGTECHNIQUESANDTOOLS                                                                                                                     |                        |                          |   |   | C05  | 9Hrs |
| Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-SiteRequestForgery(CSRF), Web3.0Architectureandsecurity. SecurityMisconfiguration,Insecure Cryptographic Storage, Failureto Restrict URLAccess, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite,etc.                                  |                                                                                                                                               |                        |                          |   |   |      |      |
| TotalHours                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                               |                        |                          |   |   | 45   |      |
| Textbooks:                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                               |                        |                          |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                                                      | Andrew Hoffman, WebApplication Security: Exploitation and Countermeasures for ModernWeb                                                       |                        |                          |   |   |      |      |

|                         |                                                                                                                                                                                            |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | Applications, First Edition, 2020, O'Reilly Media, Inc.                                                                                                                                    |
| 2                       | Bryan Sullivan, Vincent Liu, Web Application Security: A Beginner's Guide, 2012, The McGraw-Hill Companies.                                                                                |
| 3                       | Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.                                                                                                              |
| <b>Reference Books:</b> |                                                                                                                                                                                            |
| 1                       | Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.                                                                                              |
| 2                       | Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.                                                                                       |
| 3                       | Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.                                                                                                                   |
| 4                       | Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies. |
| <b>Web References:</b>  |                                                                                                                                                                                            |
| 1                       | <a href="https://www.udemy.com/topic/web-application-security-tester/">https://www.udemy.com/topic/web-application-security-tester/</a>                                                    |
| 2                       | <a href="https://onlinecourses.nptel.ac.in/noc26_cs83/preview">https://onlinecourses.nptel.ac.in/noc26_cs83/preview</a>                                                                    |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 60                    |                | 20                   |            |            |                          |
| Apply                                                       | 40                    | 100            | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| CC504.1     | 1    | 2    | 2    | 1    | 3    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 3     |
| CC504.2     | 2    | 1    | 2    | 1    | 3    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 3     |
| CC504.3     | 1    | 1    | 1    | 2    | 3    | -    | -    | -    | -    | -     | 1     | 2     | 3     | 3     |
| CC504.4     | 1    | 2    | 1    | 1    | 2    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 3     |
| CC504.5     | 1    | 2    | 2    | 2    | 2    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                           | CourseName                                                                                                                   | Category               | Hours/Week                |   |     | C    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-----|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                              |                        | L                         | T | P   |      |
| 24CC505                                                                                                                                                                                                                                                                                                                                                                                                                                                               | PRINCIPLES OF PROGRAMMING LANGUAGES                                                                                          | PE                     | 3                         | 0 | 0   | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Nature of the Course                                                                                                         | Semester               | Data Book/Codes/Standards |   |     |      |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | THEORY                                                                                                                       | -                      | -                         |   |     |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                              | Co-requisite Course(s) |                           |   |     |      |
| Programming in C ,Object Oriented Programming and Java                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                              | -                      |                           |   |     |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                              |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | To comprehend and explain the syntax and semantics of programming languages.                                                 |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | To gain knowledge of data, data types, and fundamental programming statements.                                               |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | To understand the call-return mechanism and various approaches to its implementation.                                        |                        |                           |   |     |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | To acquire knowledge of object-oriented concepts, concurrency, and event-driven programming in modern languages.             |                        |                           |   |     |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | To develop programs using non-procedural programming paradigms.                                                              |                        |                           |   |     |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                              |                        |                           |   |     |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                              |                        |                           |   |     |      |
| CC505.1                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Describe syntax and semantics of programming languages                                                                       |                        |                           |   |     | [U]  |
| CC505.2                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Implements suitable data types and basic programming constructs in solving computational problems.                           |                        |                           |   |     | [AP] |
| CC505.3                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Apply call-return mechanisms and their implementation techniques in programming languages.                                   |                        |                           |   |     | [AP] |
| CC505.4                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Apply object-oriented, concurrency, and event handling programming constructs and develop programs in Scheme, ML, and Prolog |                        |                           |   |     | [AP] |
| CC505.5                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Develop programs using non-procedural programming paradigms.                                                                 |                        |                           |   |     | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                              |                        |                           |   |     |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                | SYNTAX AND SEMANTICS                                                                                                         |                        |                           |   | C01 | 9Hrs |
| Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing                                                                                                                                                                                                                                                                       |                                                                                                                              |                        |                           |   |     |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                | DATA, DATA TYPES, AND BASIC STATEMENTS                                                                                       |                        |                           |   | C02 | 9Hrs |
| Names – variables – binding – type checking – scope – scoperules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control structures – selection – iterations – branching – guarded statements |                                                                                                                              |                        |                           |   |     |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                | SUBPROGRAMS AND IMPLEMENTATIONS                                                                                              |                        |                           |   | C03 | 9Hrs |
| Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping                                                                                                                                                                         |                                                                                                                              |                        |                           |   |     |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                | OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING                                                                          |                        |                           |   | C04 | 9Hrs |
| Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling                                                                                                                                                                                                                             |                                                                                                                              |                        |                           |   |     |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                | FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES                                                                                   |                        |                           |   | C05 | 9Hrs |
| Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages                                                                                                                                                                                                                                 |                                                                                                                              |                        |                           |   |     |      |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                              |                        |                           |   | 45  |      |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                              |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Robert W. Sebesta, "Concepts of Programming Languages", Twelfth Edition (Global Edition), Pearson, 2022.                     |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Michael L. Scott, "Programming Language Pragmatics", Fourth Edition, Elsevier, 2018.                                         |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | R. Kent Dybvig, "The Scheme programming language", Fourth Edition, Prentice Hall, 2011.                                      |                        |                           |   |     |      |
| Reference Books:                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                              |                        |                           |   |     |      |

|                        |                                                                                                                         |
|------------------------|-------------------------------------------------------------------------------------------------------------------------|
| 1                      | Jeffrey D. Ullman, "Elements of ML programming", Second Edition, Pearson, 1997.                                         |
| 2                      | W. F. Clocksin and C. S. Mellish, "Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003.       |
| 3                      | Programming Languages: Principles and Paradigms – Maurizio Gabbriellini & Simone Martini, 2010.                         |
| 4                      | Concepts in Programming Languages – John C. Mitchell, Cambridge University, 2002 (first edition).                       |
| <b>Web References:</b> |                                                                                                                         |
| 1                      | <a href="https://www.nptel.ac.in/courses/106102067">https://www.nptel.ac.in/courses/106102067</a> .                     |
| 2                      | <a href="https://www.nptelprep.in/courses/106102067/materials">https://www.nptelprep.in/courses/106102067/materials</a> |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 60                    |                | 20                   |            |            |                          |
| Apply                                                       | 40                    | 100            | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| CC505.1     | 2    | 2    | 3    | 2    | 1    | -    | -    | -    | -    | -     | 3     | 2     | 3     | 2     |
| CC505.2     | 3    | 3    | 3    | 2    | 2    | -    | -    | -    | -    | -     | 3     | 2     | 3     | 3     |
| CC505.3     | 3    | 3    | 3    | 2    | 2    | -    | -    | -    | -    | -     | 3     | 2     | 3     | 3     |
| CC505.4     | 3    | 3    | 3    | 3    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 2     | 2     |
| CC505.5     | 3    | 3    | 3    | 3    | 3    | -    | -    | -    | -    | -     | 3     | 3     | 3     | 3     |

1-low, 2-medium, 3-high, '-' - no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                     | CourseName                                                                                                                         | Category              | Hours/Week               |   |   | C    |   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|---|------|---|
|                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                    |                       | L                        | T | P |      |   |
| 24CC506                                                                                                                                                                                                                                                                                                                                                                                                                         | ADVANCEDDATABASES                                                                                                                  | PE                    | 3                        | 0 | 0 | 3    |   |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                      | NatureoftheCourse                                                                                                                  | Semester              | DataBook/Codes/Standards |   |   |      |   |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                            | THEORY                                                                                                                             | -                     | -                        |   |   |      |   |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                    | Co-requisiteCourse(s) |                          |   |   |      |   |
| Database Management Systems                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                    | -                     |                          |   |   |      |   |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                    |                       |                          |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                               | To provide knowledge on parallel and distributed database architectures.                                                           |                       |                          |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                               | To introduce intelligent database concepts and their applications.                                                                 |                       |                          |   |   |      |   |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                               | To apply XML data models, XML querying, and graphdatabase conceptsfor managing semi-structured and connected data.                 |                       |                          |   |   |      |   |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                               | To know the challenges and techniques involved in mobile database management.                                                      |                       |                          |   |   |      |   |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                               | To impartknowledge onmultimedia database design,multidimensional data structures, andemerging database technologies.               |                       |                          |   |   |      |   |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                    |                       |                          |   |   |      |   |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                    |                       |                          |   |   |      |   |
| CC506.1                                                                                                                                                                                                                                                                                                                                                                                                                         | Understandvarious database system architectures and other concepts relatedto it.                                                   |                       |                          |   |   | [U]  |   |
| CC506.2                                                                                                                                                                                                                                                                                                                                                                                                                         | Applyintelligentdatabaseconceptsandspatialdatabasemodelsinreal-worldapplications.                                                  |                       |                          |   |   | [AP] |   |
| CC506.3                                                                                                                                                                                                                                                                                                                                                                                                                         | Evaluate XML and graph database models for managing semi-structured and connecteddata in comparison with relational databases.     |                       |                          |   |   | [AP] |   |
| CC506.4                                                                                                                                                                                                                                                                                                                                                                                                                         | Apply themobile database management issuesincluding mobility impact, transactionmodels, concurrency control, and commit protocols. |                       |                          |   |   | [AP] |   |
| CC506.5                                                                                                                                                                                                                                                                                                                                                                                                                         | Apply multimedia database systems using multidimensional data structures for image,text, audio, and video data.                    |                       |                          |   |   | [AP] |   |
| CourseContents                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                    |                       |                          |   |   |      |   |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                          | PARALLELANDDDISTRIBUTEDDATABASES                                                                                                   |                       |                          |   |   | C01  | 9 |
| DatabaseSystemArchitectures:CentralizedandClient-ServerArchitectures-ServerSystemArchitectures-Parallel Systems- Distributed Systems - Parallel Databases: I/O Parallelism -Inter andIntraQueryParallelism-InterandIntraoperationParallelism-Designof ParallelSystemsDistributedDatabaseConcepts-DistributedDataStorage-DistributedTransactions-CommitProtocols-Concurrency Control- DistributedQuery Processing - Case Studies |                                                                                                                                    |                       |                          |   |   |      |   |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                          | INTELLIGENTDATABASES                                                                                                               |                       |                          |   |   | C02  | 9 |
| Active Databases: Syntax and Semantics (Starburst, Oracle, DB2) - Taxonomy- Applications- Design Principles forActiveRules-TemporalDatabases:OverviewofTemporalDatabasesTSQL2-DeductiveDatabases-RecursiveQueriesinSQL-SpatialDatabases-SpatialDataTypes-SpatialRelationships-SpatialDataStructures-Spatial AccessMethods- SpatialDBImplementation.                                                                             |                                                                                                                                    |                       |                          |   |   |      |   |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                          | XMLANDGRAPHDATABASES                                                                                                               |                       |                          |   |   | C03  | 9 |
| XMLDatabases:XMLDataModel-DTD-XMLSchema-XMLQuerying-WebDatabases-OpenDatabase Connectivity.GraphDatabases: Introduction-Comparisonwithrelationalmodeling,GraphDatabases,Consistency, Transactions, Availability,Query Features,Scaling.                                                                                                                                                                                         |                                                                                                                                    |                       |                          |   |   |      |   |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                          | MOBILEDATABASES                                                                                                                    |                       |                          |   |   | C04  | 9 |
| MobileDatabases:LocationandHandoffManagement -EffectofMobilityonDataManagement-Location DependentDataDistribution - MobileTransactionModels - ConcurrencyControl-TransactionCommitProtocols                                                                                                                                                                                                                                     |                                                                                                                                    |                       |                          |   |   |      |   |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                          | MULTIMEDIADATABASESANDEMERGINGDATABASETECHNOLOGIES                                                                                 |                       |                          |   |   | C05  | 9 |
| Multidimensional Data Structures - Image Databases - Text /Document Databases- VideoDatabases-AudioDatabases - Multimedia Database Design.Emerging Technologies: Active database - Detective database-Objectdatabase - Temporal database - Streaming databases.                                                                                                                                                                 |                                                                                                                                    |                       |                          |   |   |      |   |
| TotalHours                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                    |                       |                          |   |   | 45   |   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                    |                       |                          |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                               | AbrahamSilberschatz, HenryF. Korth, S. Sudharshan, "DatabaseSystemConcepts", SeventhEdition, TataMcGrawHill,2019.                  |                       |                          |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                               | RamezElmasri, Shamkant B. Navathe, "Fundamentals ofDatabase Systems", Seventh Edition, PearsonEducation, 2016.                     |                       |                          |   |   |      |   |

|                        |                                                                                                                                                                                         |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3                      | C.J.Date,A.Kannan, S.Swamynathan, —AnIntroductiontoDatabaseSystems, EighthEdition, PearsonEducation, 2006                                                                               |
| <b>ReferenceBooks:</b> |                                                                                                                                                                                         |
| 1                      | RaghuRamakrishnan, DatabaseManagementSystems,,4thedition, Mcgraw-Hill,2015                                                                                                              |
| 2                      | CarloZaniolo, StefanoCeri, ChristosFaloutsos, RichardT.Snodgrass,V.S.Subrahmanian, Roberto Zicari, —AdvancedDatabaseSystems, MorganKaufmannpublishers,2006.                             |
| 3                      | VijayKumar, —MobileDatabaseSystems, JohnWiley&Sons, 2006.                                                                                                                               |
| 4                      | S.K.Singh, DatabaseSystems: Concepts, Design&Applications, 2ndEdition,Pearsoneducation,2011.                                                                                            |
| <b>WebReferences:</b>  |                                                                                                                                                                                         |
| 1                      | <a href="https://www.coursera.org/learn/modern-databases-odc?utm_source=chatgpt.com">https://www.coursera.org/learn/modern-databases-odc?utm_source=chatgpt.com</a>                     |
| 2                      | <a href="https://www.udemy.com/course/certified-nosql-graph-databases/?utm_source=chatgpt.com">https://www.udemy.com/course/certified-nosql-graph-databases/?utm_source=chatgpt.com</a> |

| AssessmentbasedonContinuousandEndSemesterExamination |                      |                  |                       |            |            |                                |
|------------------------------------------------------|----------------------|------------------|-----------------------|------------|------------|--------------------------------|
| BLOOM'S<br>TAXONOMY<br>LEVEL                         | CONTINUOUSASSESSMENT |                  |                       | ASSIGNMENT | ATTENDANCE | END<br>SEMESTER<br>EXAMINATION |
|                                                      | CIA1<br>(6Marks)     | CIA2<br>(6Marks) | ModelExam<br>(8Marks) | (10Marks)  | (10Marks)  | (60Marks)                      |
| Remember                                             |                      |                  |                       | 10         | 10         | 60                             |
| Understand                                           | 80                   |                  | 20                    |            |            |                                |
| Apply                                                | 20                   | 100              | 80                    |            |            |                                |
| Analyze                                              |                      |                  |                       |            |            |                                |
| Evaluate                                             |                      |                  |                       |            |            |                                |
| Create                                               |                      |                  |                       |            |            |                                |
| <b>Total<br/>(100Marks)</b>                          | <b>6</b>             | <b>6</b>         | <b>8</b>              | <b>10</b>  | <b>10</b>  | <b>60</b>                      |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PSO<br>2 | PSO<br>3 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|
| CC506.1     | 3       | 3       | 2       | 2       | 3       | -       | -       | -       | -       | -        | 2        | 3        | 2        | 2        |
| CC506.2     | 3       | 2       | 3       | 2       | 3       | -       | -       | -       | -       | -        | 1        | 3        | 2        | 3        |
| CC506.3     | 3       | 3       | 2       | 2       | 3       | -       | -       | -       | -       | -        | 2        | 3        | 2        | 3        |
| CC506.4     | 3       | 3       | 2       | 2       | 3       | -       | -       | -       | -       | -        | 2        | 2        | 3        | 2        |
| CC506.5     | 3       | 2       | 3       | 2       | 3       | -       | -       | -       | -       | -        | 1        | 3        | 2        | 3        |

1-low,2-medium,3-high,'-'-no correlation

**VERTICAL III**  
**CLOUD COMPUTING AND DATA CENTER**  
**TECHNOLOGIES**

| Course Code                                                                                                                                                                                                                                                                                                                    | CourseName                                                                                                          | Category              | Hours/Week               |   |            | C    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|------------|------|
|                                                                                                                                                                                                                                                                                                                                |                                                                                                                     |                       | L                        | T | P          |      |
| 24CS507                                                                                                                                                                                                                                                                                                                        | DATA WAREHOUSING                                                                                                    | PE                    | 3                        | 0 | 0          | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                     | NatureoftheCourse                                                                                                   | Semester              | DataBook/Codes/Standards |   |            |      |
| 2024                                                                                                                                                                                                                                                                                                                           | Theory                                                                                                              | -                     | -                        |   |            |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                         |                                                                                                                     | Co-requisiteCourse(s) |                          |   |            |      |
| Database Management Systems                                                                                                                                                                                                                                                                                                    |                                                                                                                     | -                     |                          |   |            |      |
| CourseObjectives                                                                                                                                                                                                                                                                                                               |                                                                                                                     |                       |                          |   |            |      |
| 1                                                                                                                                                                                                                                                                                                                              | To knowthe details ofdata warehouse Architecture                                                                    |                       |                          |   |            |      |
| 2                                                                                                                                                                                                                                                                                                                              | To understand the OLAP Technology                                                                                   |                       |                          |   |            |      |
| 3                                                                                                                                                                                                                                                                                                                              | To understand the partitioning strategy                                                                             |                       |                          |   |            |      |
| 4                                                                                                                                                                                                                                                                                                                              | To differentiate various schema                                                                                     |                       |                          |   |            |      |
| 5                                                                                                                                                                                                                                                                                                                              | To understand the roles ofprocess manager & system manager                                                          |                       |                          |   |            |      |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                 |                                                                                                                     |                       |                          |   |            |      |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                                                 |                                                                                                                     |                       |                          |   |            |      |
| C507.1                                                                                                                                                                                                                                                                                                                         | Explain the concepts, components, and architecture ofa datawarehouseincludingmodernandautonomous data warehouses.   |                       |                          |   |            | [U]  |
| C507.2                                                                                                                                                                                                                                                                                                                         | Illustrate ETL processes and analyze OLAP technologies and theiroperationsindatawarehousingsystems.                 |                       |                          |   |            | [U]  |
| C507.3                                                                                                                                                                                                                                                                                                                         | Apply metadata management concepts, design data marts, and implement partitioningstrategiesindata warehouse design. |                       |                          |   |            | [AP] |
| C507.4                                                                                                                                                                                                                                                                                                                         | Apply dimensional modeling techniques and designschemas for efficientdata warehouseimplementation.                  |                       |                          |   |            | [AP] |
| C507.5                                                                                                                                                                                                                                                                                                                         | Frame roles ofprocess manager & system manager                                                                      |                       |                          |   |            | [AP] |
| CourseContents                                                                                                                                                                                                                                                                                                                 |                                                                                                                     |                       |                          |   |            |      |
| Unit-1                                                                                                                                                                                                                                                                                                                         | INTRODUCTION TO DATA WAREHOUSE                                                                                      |                       |                          |   | C01        | 9    |
| DatawarehouseIntroduction-Datawarehousecomponents-operationaldatabaseVsdatawarehouse – Data warehouseArchitecture – Three-tier Data Warehouse Architecture – AutonomousDataWarehouse- AutonomousDataWarehouseVsSnowflake – Modern Data Warehouse-Data Warehouse Administration AndManagement-Typesof distributed DataWarehouse |                                                                                                                     |                       |                          |   |            |      |
| Unit-2                                                                                                                                                                                                                                                                                                                         | ETL AND OLAP TECHNOLOGY                                                                                             |                       |                          |   | C02        | 9    |
| WhatisETL-ETLVsELT-Typesof Datawarehouses-DatawarehouseDesignandModeling-DeliveryProcess-Online Analytical Processing (OLAP) – Characteristics ofOLAP – OLAP Guidelines-Online Transaction Processing(OLTP) Vs OLAP – OLAP operations- Types ofOLAP-ROLAPVs MOLAPVsHOLAP- OLAPToolsandInternert-TheData warehouse and theweb.  |                                                                                                                     |                       |                          |   |            |      |
| Unit-3                                                                                                                                                                                                                                                                                                                         | METADATA, DATA MART AND PARTITION STRATEGIES                                                                        |                       |                          |   | C03        | 9    |
| MetaData –Categoriesof Metadata–Roleof Metadata–MetadataRepository –MetadataManagement- ChallengesforMeta Management – Data Mart – Need ofData Mart- Cost Effective Data Mart- Designing Data Marts- Cost ofData Marts-Partitioning Strategy – Vertical partition – Normalization – Row Splitting – Horizontal Partition       |                                                                                                                     |                       |                          |   |            |      |
| Unit-4                                                                                                                                                                                                                                                                                                                         | DIMENSIONAL MODELING AND SCHEMA                                                                                     |                       |                          |   | C04        | 9    |
| DimensionalModeling–Multi-DimensionalDataModeling – DataCube- StarSchema- Snowflakeschema- StarVs Snowflakeschema- Fact constellationSchema-Schema Definition- Process Architecture- TypesofDataBaseParallelism– Data warehouse Tools                                                                                          |                                                                                                                     |                       |                          |   |            |      |
| Unit-5                                                                                                                                                                                                                                                                                                                         | SYSTEM & PROCESS MANAGERS                                                                                           |                       |                          |   | C05        | 9    |
| DataWarehousing System Managers: System Configuration Manager- System Scheduling Manager – System EventManager-System DatabaseManager-System BackupRecovery Manager- DataWarehousingProcessManagers:LoadManager – Warehouse Manager- Query Manager – Hardware Architecture-Physical Layout-Security-Tuning – Testing           |                                                                                                                     |                       |                          |   |            |      |
|                                                                                                                                                                                                                                                                                                                                |                                                                                                                     |                       |                          |   | TotalHours | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                     |                                                                                                                     |                       |                          |   |            |      |

|                         |                                                                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1                       | Alejandro Vaisman and Esteban Zimányi, Data Warehouse Systems: Design and Implementation, Springer, 2022.                                    |
| 2                       | Ralph Kimball, "The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling", Third edition, 2013.                                |
| <b>Reference Books:</b> |                                                                                                                                              |
| 1                       | Paul Raj Ponniah, "Data warehousing fundamentals for IT Professionals", 2012.                                                                |
| 2                       | K. P. Soman, Shyam Diwakar and V. Ajay "Insight into Data Mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006. |
| 3                       | W. H. Inmon, "DW 2.0: The Architecture for the Next Generation of Data Warehousing Morgan Kaufmann (Elsevier)", 2008                         |
| 4                       | William H. Inmon, "Building The Data Warehouse", 2005                                                                                        |
| <b>Web References:</b>  |                                                                                                                                              |
| 1                       | <a href="https://www.acte.in/data-warehouse-basics-for-beginners">https://www.acte.in/data-warehouse-basics-for-beginners</a>                |
| 2                       | <a href="https://holowczak.com/introduction-data-warehousing">https://holowczak.com/introduction-data-warehousing</a>                        |

#### Assessment based on Continuous and End Semester Examination

| BLOOM'S TAXONOMY LEVEL   | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|--------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
|                          | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                 |                       |                |                      | 10         | 10         | 60                       |
| Understand               | 100                   | 20             | 20                   |            |            |                          |
| Apply                    |                       | 80             | 80                   |            |            |                          |
| Analyze                  |                       |                |                      |            |            |                          |
| Evaluate                 |                       |                |                      |            |            |                          |
| Create                   |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>Pos | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C507.1      | 3    | 2    |      |      | 1    |      |      |      |      |       | 1     | 2     | 1     |
| C507.2      | 3    | 3    |      | 1    | 2    |      |      |      |      |       |       | 2     | 2     |
| C507.3      | 2    | 3    | 3    | 1    | 2    |      |      |      |      |       |       | 3     | 2     |
| C507.4      | 2    | 2    | 3    | 1    | 2    |      |      |      |      |       |       | 3     | 3     |
| C507.5      | 1    | 2    | 2    | 1    | 2    |      |      |      | 2    | 2     | 1     | 2     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                 | Course Name                                                                                                                                     | Category               | Hours/Week                |   |     | C    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-----|------|
|                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                 |                        | L                         | T | P   |      |
| 24CS502                                                                                                                                                                                                                                                                                                                                                                                     | CLOUD SERVICES MANAGEMENT                                                                                                                       | PE                     | 3                         | 0 | 0   | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                  | Nature of the Course                                                                                                                            | Semester               | Data Book/Codes/Standards |   |     |      |
| 2024                                                                                                                                                                                                                                                                                                                                                                                        | THEORY                                                                                                                                          | -                      | -                         |   |     |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                 | Co-requisite Course(s) |                           |   |     |      |
| Operating Systems, Database management system                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                 | -                      |                           |   |     |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                 |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                           | Introduce Cloud Service Management terminology, definition & concepts                                                                           |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                           | Compare and contrast cloud service management with traditional IT service management                                                            |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                           | Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services                                              |                        |                           |   |     |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                           | Select appropriate structures for designing, deploying and running cloud-based services in a business environment                               |                        |                           |   |     |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                           | Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems                                             |                        |                           |   |     |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                 |                        |                           |   |     |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                 |                        |                           |   |     |      |
| C501.1                                                                                                                                                                                                                                                                                                                                                                                      | Explain the fundamental concepts of cloud service management including cloud ecosystem, characteristics, service models, and deployment models. |                        |                           |   |     | [U]  |
| C501.2                                                                                                                                                                                                                                                                                                                                                                                      | Describe cloud service strategies and management frameworks for effective adoption and implementation of cloud services.                        |                        |                           |   |     | [U]  |
| C501.3                                                                                                                                                                                                                                                                                                                                                                                      | Apply cloud service management techniques such as service lifecycle, capacity planning, migration, and operational management.                  |                        |                           |   |     | [AP] |
| C501.4                                                                                                                                                                                                                                                                                                                                                                                      | Apply cloud service economic models to analyze pricing strategies, billing mechanisms, and cost management in cloud environments.               |                        |                           |   |     | [AP] |
| C50.5                                                                                                                                                                                                                                                                                                                                                                                       | Demonstrate cloud governance frameworks and risk management practices to evaluate the value and effectiveness of cloud services.                |                        |                           |   |     | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                 |                        |                           |   |     |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                      | CLOUD SERVICE MANAGEMENT FUNDAMENTALS                                                                                                           |                        |                           |   | C01 | 9    |
| Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models Cloud Computing Architecture-Virtualization Technologies- Cloud Service Level Agreements (SLA) and Quality of Service (QoS)                                                   |                                                                                                                                                 |                        |                           |   |     |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                      | CLOUD SERVICES STRATEGY                                                                                                                         |                        |                           |   | C02 | 9    |
| Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture- Cloud Governance- Cloud Migration Strategy- Cloud Security Management- Cloud Service Level Agreement (SLA) - Cloud Resource Allocation |                                                                                                                                                 |                        |                           |   |     |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                      | CLOUD SERVICE MANAGEMENT                                                                                                                        |                        |                           |   | C03 | 9    |
| Cloud Service Reference Model, Cloud Service Life Cycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management- Cloud Governance and Compliance- Cloud Design Patterns                                  |                                                                                                                                                 |                        |                           |   |     |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                      | CLOUD SERVICE ECONOMICS                                                                                                                         |                        |                           |   | C04 | 9    |
| Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models- Cloud Service Billing and Metering- Cloud Financial Management- Resource Allocation and Cost Efficiency                                                                   |                                                                                                                                                 |                        |                           |   |     |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                      | CLOUD SERVICE GOVERNANCE & VALUE                                                                                                                |                        |                           |   | C05 | 9    |

|                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ITGovernanceDefinition, CloudGovernanceDefinition, CloudGovernanceFramework, CloudGovernance Structure, Cloud Governance Considerations, Cloud Service ModelRiskMatrix, Understanding Valueof CloudServices, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership- Cloud Cost Management and Optimization-Cloud Security and Risk Management |                                                                                                                                                                                                                                               |
| <b>TotalHours</b>                                                                                                                                                                                                                                                                                                                                                          | <b>45</b>                                                                                                                                                                                                                                     |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                               |
| 1                                                                                                                                                                                                                                                                                                                                                                          | Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications, 2023                                                                                                                       |
| 2                                                                                                                                                                                                                                                                                                                                                                          | Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2024                                                                                                                                    |
| <b>ReferenceBooks:</b>                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                               |
| 1                                                                                                                                                                                                                                                                                                                                                                          | James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.                                                                                                                 |
| 2                                                                                                                                                                                                                                                                                                                                                                          | Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.                                                                                 |
| <b>WebReferences:</b>                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                               |
| 1                                                                                                                                                                                                                                                                                                                                                                          | <a href="https://www.startertutorials.com/blog/cloud-computing-essentials.html">https://www.startertutorials.com/blog/cloud-computing-essentials.html</a>                                                                                     |
| 2                                                                                                                                                                                                                                                                                                                                                                          | <a href="https://www.linkedin.com/top-content/training-development/digital-literacy-training/cloud-computing-essentials/">https://www.linkedin.com/top-content/training-development/digital-literacy-training/cloud-computing-essentials/</a> |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 100                   | 20             | 20                   |            |            |                          |
| Apply                                                       |                       | 80             | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/ POs | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P010 | P011 | PS01 | PS02 |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C502.1   | 3   | 2   |     |     | 2   |     |     |     |     |      | 1    | 2    | 3    |
| C502.2   | 3   | 3   | 1   |     | 2   |     |     |     |     | 1    | 1    | 2    | 3    |
| C502.3   | 2   | 2   | 3   | 1   | 3   |     |     |     |     | 2    | 1    | 3    | 3    |
| C502.4   | 1   | 3   | 1   |     | 2   |     |     |     |     | 3    | 1    | 3    | 2    |
| C502.5   | 1   | 2   | 1   | 1   | 2   | 3   | 2   |     |     | 1    | 2    | 1    | 2    |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                        | Course Name                                                                                                                      | Category               | Hours/Week                |   |   | C    |      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|------|
|                                                                                                                                                                                                                                                                                                                    |                                                                                                                                  |                        | L                         | T | P |      |      |
| 24CS503                                                                                                                                                                                                                                                                                                            | VIRTUALIZATION                                                                                                                   | PE                     | 3                         | 0 | 0 | 3    |      |
| Regulation                                                                                                                                                                                                                                                                                                         | Nature of the Course                                                                                                             | Semester               | Data Book/Codes/Standards |   |   |      |      |
| R24                                                                                                                                                                                                                                                                                                                | Theory                                                                                                                           | -                      | -                         |   |   |      |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                            |                                                                                                                                  | Co-requisite Course(s) |                           |   |   |      |      |
| Foundation of Cloud Computing                                                                                                                                                                                                                                                                                      |                                                                                                                                  | Computer Networks      |                           |   |   |      |      |
| Course Objectives                                                                                                                                                                                                                                                                                                  |                                                                                                                                  |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                  | To understand the fundamentals and need for virtualization in modern computing.                                                  |                        |                           |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                  | To explore server and desktop virtualization techniques and their applications.                                                  |                        |                           |   |   |      |      |
| 3                                                                                                                                                                                                                                                                                                                  | To learn concepts and tools related to network virtualization.                                                                   |                        |                           |   |   |      |      |
| 4                                                                                                                                                                                                                                                                                                                  | To understand storage and memory virtualization techniques.                                                                      |                        |                           |   |   |      |      |
| 5                                                                                                                                                                                                                                                                                                                  | To analyze security challenges and solutions in virtualization environments.                                                     |                        |                           |   |   |      |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                    |                                                                                                                                  |                        |                           |   |   |      |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                            |                                                                                                                                  |                        |                           |   |   |      |      |
| C503.1                                                                                                                                                                                                                                                                                                             | Explain the fundamentals, need, and types of virtualization.                                                                     |                        |                           |   |   | [U]  |      |
| C503.2                                                                                                                                                                                                                                                                                                             | Analyze server and desktop virtualization techniques and their applications.                                                     |                        |                           |   |   | [AP] |      |
| C503.3                                                                                                                                                                                                                                                                                                             | Understand and apply network virtualization concepts and tools.                                                                  |                        |                           |   |   | [AP] |      |
| C503.4                                                                                                                                                                                                                                                                                                             | Apply storage and memory virtualization techniques to configure and manage efficient storage systems in real-world environments. |                        |                           |   |   | [AP] |      |
| C503.5                                                                                                                                                                                                                                                                                                             | Apply security issues and implement protection mechanisms in virtualization environments.                                        |                        |                           |   |   | [AP] |      |
| Course Contents                                                                                                                                                                                                                                                                                                    |                                                                                                                                  |                        |                           |   |   |      |      |
| Unit-1                                                                                                                                                                                                                                                                                                             | INTRODUCTION TO VIRTUALIZATION                                                                                                   |                        |                           |   |   | C01  | 9Hrs |
| Virtualization and cloud computing - Need of virtualization - cost, administration, fast deployment, reduce infrastructure cost - limitations - Types of hardware virtualization: Full virtualization - partial virtualization - Paravirtualization - Types of Hypervisors.                                        |                                                                                                                                  |                        |                           |   |   |      |      |
| Unit-2                                                                                                                                                                                                                                                                                                             | SERVER AND DESKTOP VIRTUALIZATION                                                                                                |                        |                           |   |   | C02  | 9Hrs |
| Virtual machine basics - Types of virtual machines - Understanding Server Virtualization - types of server virtualization - Business Cases for Server Virtualization - Uses of Virtual Server Consolidation - Selecting Server Virtualization Platform - Desktop Virtualization - Types of Desktop Virtualization. |                                                                                                                                  |                        |                           |   |   |      |      |
| Unit-3                                                                                                                                                                                                                                                                                                             | NETWORK VIRTUALIZATION                                                                                                           |                        |                           |   |   | C03  | 9Hrs |
| Introduction to Network Virtualization - Advantages - Functions - Tools for Network Virtualization - VLAN - WAN Architecture - WAN Virtualization.                                                                                                                                                                 |                                                                                                                                  |                        |                           |   |   |      |      |
| Unit-4                                                                                                                                                                                                                                                                                                             | STORAGE VIRTUALIZATION                                                                                                           |                        |                           |   |   | C04  | 9Hrs |
| Memory Virtualization - Types of Storage Virtualization - Block, File - Address space Remapping - Risks of Storage Virtualization - SAN - NAS - RAID.                                                                                                                                                              |                                                                                                                                  |                        |                           |   |   |      |      |
| Unit-5                                                                                                                                                                                                                                                                                                             | VIRTUALIZATION SECURITY                                                                                                          |                        |                           |   |   | C05  | 9Hrs |
| Fundamentals of Virtualization Security - Securing Hypervisors - Designing Virtual networks for security - comparing virtual and physical networks - Security recommendations for management platforms - virtual machine threats and vulnerabilities - logging and auditing.                                       |                                                                                                                                  |                        |                           |   |   |      |      |
| Total Hours                                                                                                                                                                                                                                                                                                        |                                                                                                                                  |                        |                           |   |   | 45   |      |
| Textbooks:                                                                                                                                                                                                                                                                                                         |                                                                                                                                  |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                  | William von Hagen, <i>Professional Xen Virtualization</i> , Wiley Publishing.                                                    |                        |                           |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                  | Chris Wolf and Erick M. Halter, <i>Virtualization: From the Desktop to the Enterprise</i> , Apress.                              |                        |                           |   |   |      |      |
| Reference Books:                                                                                                                                                                                                                                                                                                   |                                                                                                                                  |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                  | James E. Smith and Ravi Nair, <i>Virtual Machines: Versatile Platforms for Systems and Processes</i> , Morgan Kaufmann.          |                        |                           |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                  | Bernard Golden, <i>Virtualization for Dummies</i> , Wiley Publishing.                                                            |                        |                           |   |   |      |      |
| Web References:                                                                                                                                                                                                                                                                                                    |                                                                                                                                  |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                  | <a href="https://www.vmware.com">https://www.vmware.com</a>                                                                      |                        |                           |   |   |      |      |

|   |                                                                                                                   |
|---|-------------------------------------------------------------------------------------------------------------------|
| 2 | <a href="https://learn.microsoft.com/en-us/virtualization/">https://learn.microsoft.com/en-us/virtualization/</a> |
|---|-------------------------------------------------------------------------------------------------------------------|

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         |                          |
| Understand                                                  | 20                    | 20             | 20                   |            |            |                          |
| Apply                                                       | 80                    | 80             | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/ POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|----------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C503.1   | 3    | 2    | -    | -    | 2    | -    | -    | -    | -    | -     | 2     | 2     | -     |
| C503.2   | 3    | 3    | 2    | 2    | 3    | -    | -    | 2    | -    | -     | 2     | 3     | 2     |
| C503.3   | 3    | 3    | 3    | 2    | 3    | -    | -    | 2    | -    | -     | 2     | 3     | 2     |
| C503.4   | 3    | 2    | 2    | 2    | 3    | -    | -    | -    | -    | -     | 2     | 3     | 2     |
| C503.5   | 3    | 3    | 2    | 3    | 3    | 2    | 2    | 2    | 2    | -     | 2     | 3     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Course Name                                                                    | Category               | Hours/Week                |   |   | C    |      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                |                        | L                         | T | P |      |      |
| 24CS504                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Security And Privacy in Cloud                                                  | PE                     | 3                         | 0 | 0 | 3    |      |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Nature of the Course                                                           | Semester               | Data Book/Codes/Standards |   |   |      |      |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Theory                                                                         | -                      | -                         |   |   |      |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                | Co-requisite Course(s) |                           |   |   |      |      |
| Cloud Computing, Computer Networks                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                | Nil                    |                           |   |   |      |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To Understand the architecture and security challenges of cloud computing.     |                        |                           |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Understand cryptographic mechanisms used in cloud security.                    |                        |                           |   |   |      |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Apply secure cloud design principles and data protection techniques.           |                        |                           |   |   |      |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Apply identity management and access control mechanisms in cloud environments. |                        |                           |   |   |      |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Apply monitoring, auditing, and compliance practices for secure cloud systems. |                        |                           |   |   |      |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                |                        |                           |   |   |      |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                |                        |                           |   |   |      |      |
| C504.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Explain cloud security concepts and cryptographic mechanisms                   |                        |                           |   |   | [U]  |      |
| C504.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Describe cloud security architecture and protection mechanisms                 |                        |                           |   |   | [U]  |      |
| C504.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply identity management and access control techniques in cloud               |                        |                           |   |   | [AP] |      |
| C504.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply cloud security models and design patterns for secure deployment          |                        |                           |   |   | [AP] |      |
| C504.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply monitoring, auditing and management mechanisms in cloud security         |                        |                           |   |   | [AP] |      |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                |                        |                           |   |   |      |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | FUNDAMENTALS OF CLOUD SECURITY                                                 |                        |                           |   |   | C01  | 9Hrs |
| Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Nonrepudiation, Access Control - Fundamentals of Cryptography - Symmetric Cryptography - Public Key Cryptography - Hash Functions - Authentication Mechanisms - Digital Signatures - Role of Cryptography in Cloud Security.                                                                                                                                                   |                                                                                |                        |                           |   |   |      |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | CLOUD SECURITY DESIGN AND ARCHITECTURE                                         |                        |                           |   |   | C02  | 9Hrs |
| Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key.                         |                                                                                |                        |                           |   |   |      |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | IDENTITY MANAGEMENT AND ACCESS CONTROL                                         |                        |                           |   |   | C03  | 9Hrs |
| Identity and Access Management in Cloud - Access Control Models - Role-Based Access Control (RBAC) - Attribute-Based Access Control (ABAC) - Authentication Mechanisms - Multi-Factor Authentication - Single Sign-On (SSO) - Identity Federation - OAuth and SAML - Identity Providers and Service Consumers - Storage Access Control - Network Access Control - Operating System Hardening - Secure Boot and Measured Boot - Intrusion Detection and Prevention Systems. |                                                                                |                        |                           |   |   |      |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | CLOUD SECURITY MODELS AND DESIGN PATTERNS                                      |                        |                           |   |   | C04  | 9Hrs |
| Introduction to Security Design Patterns - Cloud Security Reference Architecture - Cloud Resource Access Control - Secure Cloud Interfaces - Cloud Bursting - Geo-tagging - Secure On-Premise Internet Access - Secure External Cloud - Secure API Gateways - Microservices Security - Container Security - DevSecOps in Cloud - Zero Trust Security Model.                                                                                                                |                                                                                |                        |                           |   |   |      |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | MONITORING, AUDITING AND MANAGEMENT                                            |                        |                           |   |   | C05  | 9Hrs |
| Introduction to Security Design Patterns - Cloud Security Reference Architecture - Cloud Resource Access Control - Secure Cloud Interfaces - Cloud Bursting - Geo-tagging - Secure On-Premise Internet Access - Secure External Cloud - Secure API Gateways - Microservices Security - Container Security - DevSecOps in Cloud - Zero Trust Security Model.                                                                                                                |                                                                                |                        |                           |   |   |      |      |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                |                        |                           |   |   | 45   |      |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                |                        |                           |   |   |      |      |

|                         |                                                                                                                                                                                                           |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                       | Tim Mather, Subra Kumaraswamy, Shahed Latif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, 1st Edition O'Reilly Media 2009, ISBN: 978-0596802769.                        |
| 2                       | Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, 1st Edition, Wiley Publishing, 2010, ISBN: 978-0470589878.                                          |
| 3                       | Vic (J.R.) Winkler, Securing the Cloud: Cloud Computer Security Techniques and Tactics, 1st Edition, Elsevier / Syngress, 2011, ISBN: 978-1597495929.                                                     |
| <b>Reference Books:</b> |                                                                                                                                                                                                           |
| 1                       | Thomas Erl, Cloud Computing: Concepts, Technology and Architecture, 1st Edition, Prentice Hall / Pearson Education, 2013, ISBN: 978-0133387520.                                                           |
| 2                       | Rajkumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing: Principles and Paradigms, 1st Edition, Wiley, 2011, ISBN: 978-0470887998.                                                              |
| <b>Web References:</b>  |                                                                                                                                                                                                           |
| 1                       | National Institute of Standards and Technology, NIST SP 800-145: The NIST Definition of Cloud Computing, NIST Publications, 2011, Available at: <a href="https://www.nist.gov">https://www.nist.gov</a> . |

**Assessment based on Continuous and End Semester Examination**

| BLOOM'S TAXONOMY LEVEL   | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|--------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
|                          | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                 |                       |                |                      | 10         | 10         | 60                       |
| Understand               | 80                    | 20             | 20                   |            |            |                          |
| Apply                    | 20                    | 80             | 80                   |            |            |                          |
| Analyze                  |                       |                |                      |            |            |                          |
| Evaluate                 |                       |                |                      |            |            |                          |
| Create                   |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C504.1      | 3    | 2    | 1    | -    | 2    | -    | -    | -    | -    | 2     | 3     | 2     | 2     |
| C504.2      | 2    | 3    | 1    | 2    | 2    | -    | -    | -    | -    | 2     | 3     | 2     | 3     |
| C504.3      | 2    | 3    | 2    | 2    | 3    | -    | -    | -    | -    | 2     | 3     | 2     | 3     |
| C504.4      | 2    | 2    | 2    | 3    | 3    | -    | -    | -    | -    | 2     | 3     | 1     | 3     |
| C504.5      | 3    | 2    | 2    | 2    | 3    | -    | -    | -    | -    | 3     | 3     | 2     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                      | Course Name                                                                                                                    | Category               | Hours/Week                |   |   | C        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----------|
|                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                |                        | L                         | T | P |          |
| 24CS505                                                                                                                                                                                                                                                                                                                          | STORAGE TECHNOLOGY                                                                                                             | PE                     | 3                         | 0 | 0 | 3        |
| Regulation                                                                                                                                                                                                                                                                                                                       | Nature of the Course                                                                                                           | Semester               | Data Book/Codes/Standards |   |   |          |
| 2024                                                                                                                                                                                                                                                                                                                             | THEORY                                                                                                                         | 5                      | -                         |   |   |          |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                          |                                                                                                                                | Co-requisite Course(s) |                           |   |   |          |
| Database Design and Management Systems                                                                                                                                                                                                                                                                                           |                                                                                                                                | Big Data Analytics     |                           |   |   |          |
| Course Objectives                                                                                                                                                                                                                                                                                                                |                                                                                                                                |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                | To understand the physical and logical components of storage.                                                                  |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                | To implement RAID and the intelligent storage systems                                                                          |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                | To set up SAN, NAS, and virtualized storage environments.                                                                      |                        |                           |   |   |          |
| 4                                                                                                                                                                                                                                                                                                                                | To demonstrate disaster recovery and backup strategies.                                                                        |                        |                           |   |   |          |
| 5                                                                                                                                                                                                                                                                                                                                | To examine security measures with the implementation of storage security mechanisms                                            |                        |                           |   |   |          |
| Course Outcomes                                                                                                                                                                                                                                                                                                                  |                                                                                                                                |                        |                           |   |   |          |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                          |                                                                                                                                |                        |                           |   |   |          |
| C505.1                                                                                                                                                                                                                                                                                                                           | Understand the information storage devices, computing platforms and data center environments                                   |                        |                           |   |   | [U]      |
| C505.2                                                                                                                                                                                                                                                                                                                           | Implementation of intelligent storage systems and RAID                                                                         |                        |                           |   |   | [AP]     |
| C505.3                                                                                                                                                                                                                                                                                                                           | Examine Storage Networking Technologies and Virtualization                                                                     |                        |                           |   |   | [AN]     |
| C505.4                                                                                                                                                                                                                                                                                                                           | Demonstrate virtualized storage environments                                                                                   |                        |                           |   |   | [AP]     |
| C505.5                                                                                                                                                                                                                                                                                                                           | Examine security measures with the implementation of storage security mechanisms                                               |                        |                           |   |   | [AN]     |
| Course Contents                                                                                                                                                                                                                                                                                                                  |                                                                                                                                |                        |                           |   |   |          |
| Unit-1                                                                                                                                                                                                                                                                                                                           | Introduction to Information Storage                                                                                            |                        |                           |   |   | C01 9Hrs |
| Digital data types (structured/unstructured), data center components, Information Lifecycle Management (ILM)-Evolution of Computing Platforms: Third Platform Technologies: Cloud computing, Big Data analytics, Social networking, and Mobile computing - Data Center Environment: Core elements, software-defined data center. |                                                                                                                                |                        |                           |   |   |          |
| Unit-2                                                                                                                                                                                                                                                                                                                           | Intelligent Storage Systems and RAID                                                                                           |                        |                           |   |   | C02 9Hrs |
| Intelligent Storage Systems: Components, architecture, and performance-RAID: RAID implementations, RAID array components, and RAID performance-Storage Types: File-based, Object-based, and Unified storage.                                                                                                                     |                                                                                                                                |                        |                           |   |   |          |
| Unit-3                                                                                                                                                                                                                                                                                                                           | Storage Networking Technologies and Virtualization                                                                             |                        |                           |   |   | C03 9Hrs |
| Storage Networking: Fibre Channel SAN (FC SAN) components, topologies, and architecture - Networking Protocols: iSCSI, FCIP, and FCoE (Fibre Channel over Ethernet) - Storage Virtualization: Block-level and file-level virtualization, software-defined storage.                                                               |                                                                                                                                |                        |                           |   |   |          |
| Unit-4                                                                                                                                                                                                                                                                                                                           | Backup, Replication, and Disaster Recovery                                                                                     |                        |                           |   |   | C04 9Hrs |
| Backup and Recovery: Information availability, business continuity, backup methods, and recovery techniques - Replication Technologies: Local and remote replication, storage-based, compute-based, and network-based replication - Disaster Recovery: Disaster recovery as a service (DRaaS).                                   |                                                                                                                                |                        |                           |   |   |          |
| Unit-5                                                                                                                                                                                                                                                                                                                           | Securing Storage Infrastructure                                                                                                |                        |                           |   |   | C05 9Hrs |
| Storage Security: Security framework, threats, and risk management - Security Measures: Security in FC SAN, iSCSI, and NAS environments - Management: Monitoring and managing storage infrastructure.                                                                                                                            |                                                                                                                                |                        |                           |   |   |          |
| Total Hours                                                                                                                                                                                                                                                                                                                      |                                                                                                                                |                        |                           |   |   | 45       |
| Textbooks:                                                                                                                                                                                                                                                                                                                       |                                                                                                                                |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                | Susanta Dutta "Computer storage fundamentals ", 2nd Edition, BPB Publications, 2025.                                           |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                | Jiwu Shu "Data Storage Architectures and Technologies", Springer publications, 2024.                                           |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                | Azam Seyedi, "Computer Memory and Data Storage", Intech Open publications , 2024.                                              |                        |                           |   |   |          |
| Reference Books:                                                                                                                                                                                                                                                                                                                 |                                                                                                                                |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                | Sachi Choudhary, "Fundamentals of Storage Technologies", Technical Publications, 2023.                                         |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                | Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw-Hill Education, 2023.                                 |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                | Vaishali Khairnar, "Storage Network Management and Retrieval", Technical Publications, 2019.                                   |                        |                           |   |   |          |
| 4                                                                                                                                                                                                                                                                                                                                | S. P. S. Saini, "Computer Storage Fundamentals: Storage System, Storage Networking, and Host Connectivity". 2nd Edition. 2020. |                        |                           |   |   |          |

| WebReferences: |                                                                                                                                                           |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1              | <a href="https://spark.apache.org/docs/latest/streaming-programming-guide.html">https://spark.apache.org/docs/latest/streaming-programming-guide.html</a> |
| 2              | <a href="https://spark.apache.org/docs/latest/streaming-kafka-integration.html">https://spark.apache.org/docs/latest/streaming-kafka-integration.html</a> |

| AssessmentbasedonContinuousandEndSemesterExamination |                      |                  |                       |            |            |                            |
|------------------------------------------------------|----------------------|------------------|-----------------------|------------|------------|----------------------------|
| BLOOM'S<br>TAXONOMY<br>LEVEL                         | CONTINUOUSASSESSMENT |                  |                       | ASSIGNMENT | ATTENDANCE | ENDSEMESTERE<br>XAMINATION |
|                                                      | CIA1<br>(6Marks)     | CIA2<br>(6Marks) | ModelExam<br>(8Marks) | (10Marks)  | (10Marks)  | (60Marks)                  |
| Remember                                             |                      |                  |                       | 10         | 10         | 60                         |
| Understand                                           | 60                   | 20               | 20                    |            |            |                            |
| Apply                                                | 40                   | 60               | 40                    |            |            |                            |
| Analyze                                              |                      | 20               | 40                    |            |            |                            |
| Evaluate                                             |                      |                  |                       |            |            |                            |
| Create                                               |                      |                  |                       |            |            |                            |
| <b>Total<br/>(100Marks)</b>                          | <b>6</b>             | <b>6</b>         | <b>8</b>              | <b>10</b>  | <b>10</b>  | <b>60</b>                  |

- CIA1, CIA 2 and ModelExam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PSO<br>2 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|
| C505.1      | 3       | 3       | 2       | 2       | 2       | 2       | -       | -       | -       | 2        | 2        | 2        | 2        |
| C505.2      | 3       | 3       | 2       | 2       | 2       | 3       | -       | -       | -       | 3        | 2        | 3        | 3        |
| C505.3      | 3       | 3       | 2       | 3       | 2       | 2       | -       | -       | -       | 2        | 2        | 3        | 3        |
| C505.4      | 3       | 2       | 3       | 2       | 2       | 2       | -       | -       | -       | 3        | 2        | 3        | 3        |
| C505.5      | 3       | 3       | 3       | 3       | 2       | 2       | -       | -       | -       | 2        | 3        | 3        | 3        |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                             | Course Name                                                                                                                            | Category               | Hours/Week                |   |   | C        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----------|
|                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                        |                        | L                         | T | P |          |
| 24CS506                                                                                                                                                                                                                                                                                                                                                                 | STREAMPROCESSING                                                                                                                       | PE                     | 3                         | 0 | 0 | 3        |
| Regulation                                                                                                                                                                                                                                                                                                                                                              | Nature of the Course                                                                                                                   | Semester               | Data Book/Codes/Standards |   |   |          |
| 2024                                                                                                                                                                                                                                                                                                                                                                    | THEORY                                                                                                                                 | -                      | -                         |   |   |          |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                        | Co-requisite Course(s) |                           |   |   |          |
| Database Design and Management Systems                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                        | Big Data Analytics     |                           |   |   |          |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                        |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                                       | To introduce data processing paradigms and modern data systems for real-time concepts                                                  |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                                       | To select appropriate structures for business-oriented real-time data services                                                         |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                                                       | To understand and identify the architectures for storage systems in distributed systems and stream processing                          |                        |                           |   |   |          |
| 4                                                                                                                                                                                                                                                                                                                                                                       | To design and implement real-time applications using Apache Spark or Kafka                                                             |                        |                           |   |   |          |
| 5                                                                                                                                                                                                                                                                                                                                                                       | To implement Spark structured streaming and design fault tolerance in streaming systems                                                |                        |                           |   |   |          |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                        |                        |                           |   |   |          |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                 |                                                                                                                                        |                        |                           |   |   |          |
| C506.1                                                                                                                                                                                                                                                                                                                                                                  | Summarize data processing paradigms and modern data systems                                                                            |                        |                           |   |   | [U]      |
| C506.2                                                                                                                                                                                                                                                                                                                                                                  | Describe data management strategies and NoSQL data models                                                                              |                        |                           |   |   | [AP]     |
| C506.3                                                                                                                                                                                                                                                                                                                                                                  | identify the architectures for storage systems in distributed systems and stream processing                                            |                        |                           |   |   | [AP]     |
| C506.4                                                                                                                                                                                                                                                                                                                                                                  | Make use of Kafka in event processing systems and design use cases for event driven systems                                            |                        |                           |   |   | [AP]     |
| C506.5                                                                                                                                                                                                                                                                                                                                                                  | Execute real time analytics in streaming applications using Apache Spark                                                               |                        |                           |   |   | [AP]     |
| Course Contents                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                        |                        |                           |   |   |          |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                  | Data Systems & Processing Models                                                                                                       |                        |                           |   |   | C01 9Hrs |
| Overview of modern data systems and data processing paradigms: batch processing vs stream processing-Characteristics and applications of batch processing -Characteristics and applications of real-time stream processing - differences between batch and stream processing- Use cases and industry applications.                                                      |                                                                                                                                        |                        |                           |   |   |          |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                  | Data Management Strategies and Data Models                                                                                             |                        |                           |   |   | C02 9Hrs |
| Data management in large-scale distributed systems-Data storage strategies and scalability considerations-Overview of NoSQL databases-Types of NoSQL databases:Key-Value Stores-Document Databases-Column-Oriented Databases-Graph Databases Introduction to Graph Data Models-Comparison of relational and NoSQL data models Applications of graph-based data systems. |                                                                                                                                        |                        |                           |   |   |          |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                  | Stream Processing Technologies                                                                                                         |                        |                           |   |   | C03 9Hrs |
| Introduction to real-time data processing frameworks`-Stream processing architecture and workflow Lambda Architecture-Batch layer, Speed layer, Serving layer Kappa Architecture-Concept and benefits-Distributed storage systems in stream processing- Data ingestion and data flow management-Stream processing pipelines.                                            |                                                                                                                                        |                        |                           |   |   |          |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                  | Event Processing with Kafka                                                                                                            |                        |                           |   |   | C04 9Hrs |
| Introduction to Apache Kafka- Kafka architecture and ecosystem-Components of Kafka-Kafka data flow and message handling -Kafka Producer API - Kafka Consumer API -Kafka use cases in event-driven systems.                                                                                                                                                              |                                                                                                                                        |                        |                           |   |   |          |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                  | Spark Streaming                                                                                                                        |                        |                           |   |   | C05 9Hrs |
| Introduction to Apache Spark and streaming analytics-Overview of Spark Structured Streaming-Micro-batch processing model-Window-based stream processing-Watermarking for late data handling-Fault tolerance in streaming systems-Checkpointing and recovery mechanisms-Real-time analytics applications.                                                                |                                                                                                                                        |                        |                           |   |   |          |
| Total Hours                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                        |                        |                           |   |   | 45       |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                        |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                                       | Joe Reis, Matt Housley, Reuven Lax, "Fundamentals of Data Engineering: Plan and Build Robust Data Systems" O'Reilly Media, 2022.       |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                                       | Fabian Hueske, Vasiliki Kalavri, "Fundamentals of Stream Processing: Application Design, Systems, and Analytics", O'Reilly Media, 2019 |                        |                           |   |   |          |

|   |                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | Martin Kleppmann, "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems", O'Reilly Media, 2017. |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------|

| Reference Books: |                                                                                                                                                                      |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                | Fabian Hueske, Vasiliki Kalavri, "Stream Processing with Apache Flink: Fundamentals, Implementation, and Operation of Streaming Applications", O'Reilly Media, 2019. |
| 2                | Mayank Pandey, "Kafka Streams: Real-Time Stream Processing", Packet Publishing, 2019.                                                                                |
| 3                | Ben Stopford, "Designing Event-Driven Systems: Concepts and Patterns for Streaming Services with Apache Kafka", O'Reilly Media, 2018.                                |
| Web References:  |                                                                                                                                                                      |
| 1                | <a href="https://flink.apache.org/">https://flink.apache.org/</a>                                                                                                    |
| 2                | <a href="https://docs.databricks.com/">https://docs.databricks.com/</a>                                                                                              |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 60                    | 40             | 40                   |            |            |                          |
| Apply                                                       | 40                    | 60             | 60                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C506.1      | 3    | 3    | 2    | 3    | 1    | -    | -    | -    | 2    | 3     | 3     | 2     | 3     |
| C506.2      | 2    | 2    | 2    | 3    | 3    | -    | -    | -    | 2    | 2     | 3     | 3     | 3     |
| C506.3      | 3    | 2    | 2    | 3    | 3    | -    | -    | -    | 2    | 2     | 3     | 3     | 2     |
| C506.4      | 2    | 3    | 3    | 3    | 3    | -    | -    | -    | 2    | 2     | 2     | 3     | 2     |
| C506.5      | 3    | 3    | 3    | 2    | 2    | -    | -    | -    | 2    | 3     | 3     | 3     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

**VERTICALIV  
EMERGINGTECHNOLOGIES**

| Course Code                                                                                                                                                                                                                                                                                                                                                                          | Course Name                                                                                                                       | Category               | Hours/Week                |   |             | C  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-------------|----|
|                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                   |                        | L                         | T | P           |    |
| 24AD508                                                                                                                                                                                                                                                                                                                                                                              | AUGMENTED REALITY/VIRTUAL REALITY                                                                                                 | PE                     | 3                         | 0 | 0           | 3  |
| Regulation                                                                                                                                                                                                                                                                                                                                                                           | Nature of the Course                                                                                                              | Semester               | Data Book/Codes/Standards |   |             |    |
| 2024                                                                                                                                                                                                                                                                                                                                                                                 | THEORY                                                                                                                            | -                      | -                         |   |             |    |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                   | Co-requisite Course(s) |                           |   |             |    |
|                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                   |                        |                           |   |             |    |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                   |                        |                           |   |             |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                    | Explain fundamentals of Virtual Reality Systems                                                                                   |                        |                           |   |             |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                    | Summarize the Fundamentals of VR and hardware and software of the Virtual Reality                                                 |                        |                           |   |             |    |
| 3                                                                                                                                                                                                                                                                                                                                                                                    | To learn about the graphical processing units and their architectures                                                             |                        |                           |   |             |    |
| 4                                                                                                                                                                                                                                                                                                                                                                                    | To gain knowledge about AR/VR application development.                                                                            |                        |                           |   |             |    |
| 5                                                                                                                                                                                                                                                                                                                                                                                    | Understand the usage of Augmented Reality                                                                                         |                        |                           |   |             |    |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                   |                        |                           |   |             |    |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                              |                                                                                                                                   |                        |                           |   |             |    |
| C508.1                                                                                                                                                                                                                                                                                                                                                                               | Understand the basic concepts of Virtual Reality Fundamentals                                                                     |                        |                           |   |             | U  |
| C508.2                                                                                                                                                                                                                                                                                                                                                                               | Differentiate the O/P devices of VR                                                                                               |                        |                           |   |             | U  |
| C508.3                                                                                                                                                                                                                                                                                                                                                                               | Discuss various modeling techniques of VR                                                                                         |                        |                           |   |             | AP |
| C508.4                                                                                                                                                                                                                                                                                                                                                                               | Predict various Applications of VR                                                                                                |                        |                           |   |             | AP |
| C508.5                                                                                                                                                                                                                                                                                                                                                                               | Illustrate working principles of AR                                                                                               |                        |                           |   |             | AP |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                   |                        |                           |   |             |    |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                               | INTRODUCTION                                                                                                                      |                        |                           |   | C01         | 9  |
| Introduction: The three I's of virtual reality, commercial VR technology and the five classic components of a VR system.<br>Input Devices: Three-dimensional position trackers, navigation and manipulation.                                                                                                                                                                         |                                                                                                                                   |                        |                           |   |             |    |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                               | OUTPUT DEVICES                                                                                                                    |                        |                           |   | C02         | 9  |
| Gesture Interfaces - The Pinch Glove, The 5DT Data Glove, The Didjiglove, The CyberGlove - Gesture Interfaces - Types of Gesture Input Devices<br>Output Devices - Graphics Display - Human Visual System - Personal Graphics Displays - Large - Volume Displays - Sound Displays - Human Auditory System.                                                                           |                                                                                                                                   |                        |                           |   |             |    |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                               | MODELING AND VR PROGRAMMING                                                                                                       |                        |                           |   | C03         | 9  |
| Modeling: Geometric modelling - Kinematics Modeling - Physical Modeling - behavior modelling - model management. VR Programming - Toolkits and Scene Graphs - World Tool Kit - Java 3D - Comparison of World Tool Kit and Java 3D                                                                                                                                                    |                                                                                                                                   |                        |                           |   |             |    |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                               | APPLICATIONS                                                                                                                      |                        |                           |   | C04         | 9  |
| Human Factors in VR - Methodology and Terminology - VR Health and Safety Issues - VR and Society - Medical Applications of VR - Education, Arts and Entertainment - Military VR Applications - Emerging Applications of VR - VR Applications in Manufacturing - Applications of VR in Robotics - Information Visualization - VR in Business - VR in Entertainment - VR in Education. |                                                                                                                                   |                        |                           |   |             |    |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                               | AUGMENTED REALITY                                                                                                                 |                        |                           |   | C05         | 9  |
| Introduction to Augmented Reality - Augmented Reality Concepts - Working principles of Augmented Reality. Visualization techniques for augmented reality. Computer vision for AR - Interaction - Modelling and Annotation - Navigation - Wearable devices.                                                                                                                           |                                                                                                                                   |                        |                           |   |             |    |
|                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                   |                        |                           |   | Total Hours | 45 |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                   |                        |                           |   |             |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                    | Samuel Greengard, Steven Jay Cohen, "Virtual Reality", Gilden Media, First Edition, 2019                                          |                        |                           |   |             |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                    | Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018 |                        |                           |   |             |    |

|                         |                                                                                                                                                                                                                      |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3                       | Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016                                                                                                                |
| <b>Reference Books:</b> |                                                                                                                                                                                                                      |
| 1                       | John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.                                                                                                                                                |
| 2                       | William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann, 2003                                                                                            |
| 3                       | Gregory C. Burdea & Philippe Coiffet, "Virtual Reality Technology", Second Edition, John Wiley & Sons, 2006                                                                                                          |
| 4                       | Allan Fowler – AR Game Development II, 1st Edition, Apress Publications, 2018, ISBN 978-1484236178                                                                                                                   |
| <b>Web References:</b>  |                                                                                                                                                                                                                      |
| 1                       | <a href="https://techooid.com/input-devices-vr">https://techooid.com/input-devices-vr</a><br><a href="https://www.marxentlabs.com/what-is-virtual-reality/">https://www.marxentlabs.com/what-is-virtual-reality/</a> |
| 2                       | <a href="https://www.techtarget.com/whatis/definition/virtual-reality">https://www.techtarget.com/whatis/definition/virtual-reality</a>                                                                              |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 100%                  | 20%            | 40%                  |            |            |                          |
| Apply                                                       |                       | 80%            | 60%                  |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/POs | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P010 | P011 | PS01 | PS02 | PS03 |
|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| C508.1  | 3   | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | 1    | 2    | 2    | 2    |
| C508.2  | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | 2    | 3    | 2    | 2    |
| C508.3  | 3   | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | 1    | 3    | 2    | 2    |
| C508.4  | 3   | 3   | 3   | 2   | -   | -   | -   | -   | -   | -    | 2    | 3    | 2    | 2    |
| C508.5  | 3   | 3   | 3   | 3   | -   | -   | -   | -   | -   | -    | 3    | 3    | 3    | 3    |

1-Low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                | Course Name                                                                                                                           | Category               | Hours/Week                |   |   | C   |   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|-----|---|
|                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                       |                        | L                         | T | P |     |   |
| 24AD510                                                                                                                                                                                                                                                                                                                                                                                                    | CYBERSECURITY                                                                                                                         | PE                     | 3                         | 0 | 0 | 3   |   |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                 | Nature of the Course                                                                                                                  | Semester               | Data Book/Codes/Standards |   |   |     |   |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                       | THEORY                                                                                                                                |                        | -                         |   |   |     |   |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                       | Co-requisite Course(s) |                           |   |   |     |   |
| Computer Network, Network Security                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                       | -                      |                           |   |   |     |   |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                       |                        |                           |   |   |     |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                          | To understand the fundamental concepts of cybersecurity, security goals, threat landscape and cyber laws including the Indian IT Act. |                        |                           |   |   |     |   |
| 2                                                                                                                                                                                                                                                                                                                                                                                                          | To analyze various cyber threats, malware types, social engineering techniques and web/network attacks.                               |                        |                           |   |   |     |   |
| 3                                                                                                                                                                                                                                                                                                                                                                                                          | To perform reconnaissance, scanning and vulnerability assessment using standard security tools.                                       |                        |                           |   |   |     |   |
| 4                                                                                                                                                                                                                                                                                                                                                                                                          | To understand intrusion detection systems, monitoring techniques and security event management concepts.                              |                        |                           |   |   |     |   |
| 5                                                                                                                                                                                                                                                                                                                                                                                                          | To configure and implement firewall technologies and intrusion prevention mechanisms in controlled environments.                      |                        |                           |   |   |     |   |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                       |                        |                           |   |   |     |   |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                       |                        |                           |   |   |     |   |
| C510.1                                                                                                                                                                                                                                                                                                                                                                                                     | Explain the fundamental principles of cybersecurity, security goals and cyber laws.                                                   |                        |                           |   |   | U   |   |
| C510.2                                                                                                                                                                                                                                                                                                                                                                                                     | Examine various cyber threats, vulnerabilities and attack mechanisms in computing systems.                                            |                        |                           |   |   | AP  |   |
| C510.3                                                                                                                                                                                                                                                                                                                                                                                                     | Apply various tools to perform information gathering.                                                                                 |                        |                           |   |   | AP  |   |
| C510.4                                                                                                                                                                                                                                                                                                                                                                                                     | Use intrusion techniques to detect intrusion                                                                                          |                        |                           |   |   | AP  |   |
| C510.5                                                                                                                                                                                                                                                                                                                                                                                                     | Demonstrate intrusion prevention techniques to prevent intrusion                                                                      |                        |                           |   |   | AP  |   |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                       |                        |                           |   |   |     |   |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                     | UNIT- FOUNDATIONS OF CYBERSECURITY                                                                                                    |                        |                           |   |   | C01 | 9 |
| Introduction to Cyber Security – Evolution of Internet and its Impact – Security Goals (Confidentiality, Integrity, Availability) – Need for Cyber Security – Threat Landscape – Cyber Crime: History and Classification – Cyber criminals and Motivations – Global Perspective on Cyber Crimes – Cyber Laws – The Indian IT Act – Data Privacy Act- Cybercrime Investigation and Punishment.              |                                                                                                                                       |                        |                           |   |   |     |   |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                     | CYBER THREATS AND DEFENSE MECHANISMS                                                                                                  |                        |                           |   |   | C02 | 9 |
| Overview of OWASP – Security Breaches and Case Studies – Threats and Vulnerabilities – Types of Malicious Attacks – Malware (Virus, Worm, Trojan, Ransomware, Spyware) – Social Engineering Techniques – Data poisoning Attacks – adversarial attacks – Wireless Network Attacks – Web Application Attacks – Common Attack Vectors – Attack Tools and Basic Countermeasures – Security of AI Systems.      |                                                                                                                                       |                        |                           |   |   |     |   |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                     | RECONNAISSANCE AND VULNERABILITY SCANNING                                                                                             |                        |                           |   |   | C03 | 9 |
| Foot printing and Information Gathering – Harvester – Whois – Netcraft – Host – DNS Information Extraction – Email Server Information Extraction – Scanning Concepts – Port Scanning and Network Scanning – Vulnerability Scanning – Scanning Methodology – Ping Sweep Techniques – Nmap<br>Command Switches – SYN, Stealth, XMAS, NULL, IDLE, FIN Scans – Banner Grabbing – OS Fingerprinting Techniques. |                                                                                                                                       |                        |                           |   |   |     |   |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                     | INTRUSION DETECTION AND SECURITY MONITORING                                                                                           |                        |                           |   |   | C04 | 9 |
| Host-Based Intrusion Detection Systems – Network-Based Intrusion Detection Systems – Distributed and Hybrid IDS – Intrusion Detection Exchange Format – Honeypots – Snort Architecture and Configuration – Basic Security Event Monitoring Concepts                                                                                                                                                        |                                                                                                                                       |                        |                           |   |   |     |   |

|                                                                                                                                                                                                                                                                                |                                                                                                                 |     |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----|----|
| Unit-5                                                                                                                                                                                                                                                                         | INTRUSION PREVENTION AND FIREWALL TECHNOLOGIES                                                                  | C05 | 9  |
| Firewalls and Intrusion Prevention Systems – Need for Firewalls – Firewall Characteristics – Access Control Policies – Types of Firewalls – Firewall Placement and Configurations – Next Generation Firewalls – Intrusion Prevention Systems – Unified Threat Management (UTM) |                                                                                                                 |     |    |
| Total Hours                                                                                                                                                                                                                                                                    |                                                                                                                 |     | 45 |
| Textbooks:                                                                                                                                                                                                                                                                     |                                                                                                                 |     |    |
| 1                                                                                                                                                                                                                                                                              | Anand Shinde, <i>Introduction to Cyber Security: Guide to the World of Cyber Security</i> , Notion Press, 2021. |     |    |
| 2                                                                                                                                                                                                                                                                              | Nina Godbole and Sunit Belapure, <i>Cyber Security</i> , Wiley India.                                           |     |    |
| 3                                                                                                                                                                                                                                                                              | Charles P. Pfleeger & Shari Lawrence Pfleeger, <i>Security in Computing</i> , Pearson                           |     |    |
| Reference Books:                                                                                                                                                                                                                                                               |                                                                                                                 |     |    |
| 1                                                                                                                                                                                                                                                                              | William Stallings, <i>Cryptography and Network Security</i> , Pearson.                                          |     |    |
| 2                                                                                                                                                                                                                                                                              | Michael E. Whitman & Herbert J. Mattord, <i>Principles of Information Security</i> , Cengage.                   |     |    |
| 3                                                                                                                                                                                                                                                                              | Ric Messier, <i>CEH v11 Study Guide</i> , Wiley.                                                                |     |    |
| 4                                                                                                                                                                                                                                                                              | The Information Technology Act, 2000 (Amended 2008), Government of India                                        |     |    |
| Web References:                                                                                                                                                                                                                                                                |                                                                                                                 |     |    |
| 1                                                                                                                                                                                                                                                                              | <a href="https://owasp.org/www-project-top-ten/">https://owasp.org/www-project-top-ten/</a>                     |     |    |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 80                    |                | 20                   |            |            |                          |
| Apply                                                       | 20                    | 100            | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C510.1      | 3    | 2    | 1    | 1    | -    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 2     |
| C510.2      | 2    | 3    | 2    | 2    | -    | -    | -    | -    | -    | -     | 1     | 3     | 2     | 1     |
| C510.3      | 2    | 3    | 2    | 3    | -    | -    | -    | -    | -    | -     | 1     | 3     | 2     | 2     |
| C510.4      | 2    | 3    | 2    | 3    | -    | -    | -    | -    | -    | -     | 1     | 3     | 2     | 2     |
| C510.5      | 2    | 2    | 3    | 2    | -    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 1     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                          | CourseName                                                                                                                                                       | Category                          | Hours/Week               |   |     | C    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------------------|---|-----|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                  |                                   | L                        | T | P   |      |
| 25AM501                                                                                                                                                                                                                                                                                                                                                                                                              | Cryptocurrency and Blockchain Technology                                                                                                                         | PE                                | 3                        | 0 | 0   | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                           | NatureoftheCourse                                                                                                                                                | Semester                          | DataBook/Codes/Standards |   |     |      |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                 | Theory                                                                                                                                                           |                                   | Nil                      |   |     |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                  | Co-requisiteCourse(s)             |                          |   |     |      |
| Computer Networks,<br>Data Structures and Algorithms                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                  | Cryptography and Network Security |                          |   |     |      |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                  |                                   |                          |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                    | To understand the basics of Blockchain                                                                                                                           |                                   |                          |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                    | To learn Different protocols and consensus algorithms in Blockchain                                                                                              |                                   |                          |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                    | To learn the Blockchain implementation frameworks                                                                                                                |                                   |                          |   |     |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                    | To provide knowledge ofcryptographic techniques used for securing blockchain systems.                                                                            |                                   |                          |   |     |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                    | To provide an understanding ofblockchain applications in emerging technologies.                                                                                  |                                   |                          |   |     |      |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                  |                                   |                          |   |     |      |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                  |                                   |                          |   |     |      |
| C501.1                                                                                                                                                                                                                                                                                                                                                                                                               | Understand the concepts of Bitcoin, mining, wallets, and token ecosystems                                                                                        |                                   |                          |   |     | [U]  |
| C501.2                                                                                                                                                                                                                                                                                                                                                                                                               | Describe the working principlesof Bitcoinandcryptocurrenciesincludingtransactionprocessing, mining, scripting, wallets, and security mechanisms.                 |                                   |                          |   |     | [U]  |
| C501.3                                                                                                                                                                                                                                                                                                                                                                                                               | Understand blockchain consensus mechanismssuch asProof of Work(PoW),Proof of Stake(PoS), and Proof of Burn (PoB) in the cryptocurrency ecosystem.                |                                   |                          |   |     | [U]  |
| C501.4                                                                                                                                                                                                                                                                                                                                                                                                               | Applycryptographictechniquessuchaspublic-privatekeys,digitalsignatures,hashfunctions, and Elliptic Curve Cryptography to enhance security in blockchain systems. |                                   |                          |   |     | [AP] |
| C501.5                                                                                                                                                                                                                                                                                                                                                                                                               | ApplyblockchainconceptstoemergingapplicationsincludingNFTs,CentralBankDigital Currencies(CBDCs), andInternetofThings(IoT) basedsystems.                          |                                   |                          |   |     | [AP] |
| CourseContents                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                  |                                   |                          |   |     |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                               | INTRODUCTIONTOCRYPTOCURRENCIES                                                                                                                                   |                                   |                          |   | C01 | 9    |
| Definition and characteristics-Digital currency vs. traditionalcurrency-Decentralization anddistributedledgertechnology-Originsof cryptocurrencies-Historicalchallengesandsuccesses-Componentsof ablockchain-Overviewof Bitcoin-Mining and the creation of new coins-Wallets and transactionson theBitcoinnetwork-alternativecryptocurrencies(Altcoins)-Token creation and use cases-Initial Coin Offerings (ICOs) . |                                                                                                                                                                  |                                   |                          |   |     |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                               | BITCOINANDCRYPTOCURRENCY                                                                                                                                         |                                   |                          |   | C02 | 9    |
| Abasiccryptocurrency,Creationofcoins, Paymentsanddoublespending,FORTH –theprecursorfor Bitcoin scripting, BitcoinScripts , BitcoinP2PNetwork, TransactioninBitcoinNetwork, BlockMining, Blockpropagationandblock relay-Bitcoin Wallets and Key Management-Bitcoin Consensus Mechanism-Bitcoin Security and Attacks.                                                                                                  |                                                                                                                                                                  |                                   |                          |   |     |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                               | BITCOINCONSENSUS                                                                                                                                                 |                                   |                          |   | C03 | 9    |
| BitcoinConsensus, ProofofWork(PoW)- HashcashPoW , BitcoinPoW, AttacksonPoW ,monopolyproblem-Proofof Stake- Proof of Burn - Proof of Elapsed Time - BitcoinMiner,MiningDifficulty,MiningPool- Permissionedmodelanduse cases- Litecoin-Namecoin-Peercoin-Cryptocurrency ecosystem                                                                                                                                      |                                                                                                                                                                  |                                   |                          |   |     |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                               | BLOCHCHAINSECURITY                                                                                                                                               |                                   |                          |   | C04 | 9    |
| CryptographicSecurityinBlockchain:Publicandprivatekeys,digitalsignatures,cryptographic hashfunctionsandtheir properties, key management and secure practices, useof hash functionsinBlockchainsecurity,Diffie-Hellmankey exchange, Elliptic Curve Cryptography (ECC), and quantum-resistant cryptographic algorithms.                                                                                                |                                                                                                                                                                  |                                   |                          |   |     |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                               | EMERGINGTRENDSANDFUTUREDEVELOPMENTS                                                                                                                              |                                   |                          |   | C05 | 9    |
| Introduction toNFTs-ERC-721 andother token standards-Applications beyond digitalart andcollectibles- Overviewof CBDCs-The role ofgovernments and central banks in digital currencies-Impact on the traditional financial system-Internet of Things(IoT) and blockchain applications-Future trends in theintegrationof emergingtechnologieswithblockchain.                                                            |                                                                                                                                                                  |                                   |                          |   |     |      |
| TotalHours                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                  |                                   |                          |   |     | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                  |                                   |                          |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                    | Arvind Narayanan et al., Bitcoin and Cryptocurrency Technologies, Princeton University Press, 2016.                                                              |                                   |                          |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                    | AndreasM. Antonopoulos, MasteringBitcoin, O'ReillyMedia, 2ndEdition,2017.                                                                                        |                                   |                          |   |     |      |
| ReferenceBooks:                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                  |                                   |                          |   |     |      |

|   |                                                                          |
|---|--------------------------------------------------------------------------|
| 1 | Imran Bashir, Mastering Blockchain, Packt Publishing, 3rd Edition, 2020. |
|---|--------------------------------------------------------------------------|

|   |                                                                       |
|---|-----------------------------------------------------------------------|
| 2 | Daniel Drescher, Blockchain Basics, Apress, 2017.                     |
| 3 | Don Tapscott and Alex Tapscott, Blockchain Revolution, Penguin, 2016. |

**Web References:**

|   |                                                                                                                                                    |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Bitcoin and Cryptocurrency Technologies – <a href="https://bitcoinbook.cs.princeton.edu">https://bitcoinbook.cs.princeton.edu</a>                  |
| 2 | Ethereum Foundation Documentation – <a href="https://ethereum.org/en/developers/docs/">https://ethereum.org/en/developers/docs/</a>                |
| 3 | Mastering Bitcoin by Andreas M. Antonopoulos – <a href="https://github.com/bitcoinbook/bitcoinbook">https://github.com/bitcoinbook/bitcoinbook</a> |

| Assessment based on Continuous and End Semester Examination |                       |                   |                            |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|----------------------------|------------|------------|--------------------------|
| BLOOM'S<br>TAXONOMY<br>LEVEL                                | CONTINUOUS ASSESSMENT |                   |                            | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model<br>Exam<br>(8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                   |                            | 10         | 10         | 60                       |
| Understand                                                  | 100%                  | 60%               | 60%                        |            |            |                          |
| Apply                                                       |                       | 40%               | 40%                        |            |            |                          |
| Analyze                                                     |                       |                   |                            |            |            |                          |
| Evaluate                                                    |                       |                   |                            |            |            |                          |
| Create                                                      |                       |                   |                            |            |            |                          |
| <b>Total<br/>(100 Marks)</b>                                | 6                     | 6                 | 8                          | 10         | 10         | 60                       |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PS01 | PS02 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C501.1      | 3   | 2   |     |     | 1   |     |     |     |     |      | 1    | 2    | 1    |
| C501.2      | 3   | 2   |     |     | 3   |     |     |     |     |      | 1    | 2    | 2    |
| C501.3      | 2   | 3   | 1   |     | 2   |     |     |     |     |      | 1    | 3    | 2    |
| C501.4      | 2   | 3   | 3   | 1   | 3   |     |     |     |     |      | 1    | 2    | 3    |
| C501.5      | 1   | 2   | 3   | 2   | 2   |     |     |     |     |      | 1    | 3    | 3    |

1-low, 2-medium, 3-high, '-' - no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                     | CourseName                                                                                                                            | Category              | Hours/Week               |   |            | C     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|------------|-------|
|                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                       |                       | L                        | T | P          |       |
| 24AM502                                                                                                                                                                                                                                                                                                                                                         | VIDEOCREATION ANDEDITING                                                                                                              | PE                    | 3                        | 0 | 0          | 3     |
| Regulation                                                                                                                                                                                                                                                                                                                                                      | NatureoftheCourse                                                                                                                     | Semester              | DataBook/Codes/Standards |   |            |       |
| R24                                                                                                                                                                                                                                                                                                                                                             | THEORY                                                                                                                                | -                     | -                        |   |            |       |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                       | Co-requisiteCourse(s) |                          |   |            |       |
| --                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                       | -                     |                          |   |            |       |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                       |                       |                          |   |            |       |
| 1                                                                                                                                                                                                                                                                                                                                                               | To understand the fundamentals and evolution of digital video and editing                                                             |                       |                          |   |            |       |
| 2                                                                                                                                                                                                                                                                                                                                                               | To develop storytelling skills using modern editing techniques                                                                        |                       |                          |   |            |       |
| 3                                                                                                                                                                                                                                                                                                                                                               | To capture, edit, and produce professional-quality video and audio                                                                    |                       |                          |   |            |       |
| 4                                                                                                                                                                                                                                                                                                                                                               | To work with industry-standard non-linear editing(NLE) tools                                                                          |                       |                          |   |            |       |
| 5                                                                                                                                                                                                                                                                                                                                                               | To apply emerging technologies in video production and post-production                                                                |                       |                          |   |            |       |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                       |                       |                          |   |            |       |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                                                                                  |                                                                                                                                       |                       |                          |   |            |       |
| C502.1                                                                                                                                                                                                                                                                                                                                                          | Apply the fundamentals and ethical principles of digital video editing in creatingvideo content.                                      |                       |                          |   |            | [AP]  |
| C502.2                                                                                                                                                                                                                                                                                                                                                          | Apply storytelling techniques to create engaging video narratives                                                                     |                       |                          |   |            | [AP]  |
| C502.3                                                                                                                                                                                                                                                                                                                                                          | Apply digital tools and editing techniques to capture and produce audio-visualcontent.                                                |                       |                          |   |            | [AP]  |
| C502.4                                                                                                                                                                                                                                                                                                                                                          | Apply non-linear editing workflows using industry-standard software                                                                   |                       |                          |   |            | [AP]  |
| C502.5                                                                                                                                                                                                                                                                                                                                                          | Analyze and apply emerging technologies in video creation and post-production                                                         |                       |                          |   |            | [AN]  |
| CourseContents                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                       |                       |                          |   |            |       |
| Unit-1                                                                                                                                                                                                                                                                                                                                                          | FUNDAMENTALSOFDIGITALVIDEOANDEDITING                                                                                                  |                       |                          |   | C01        | 9Hrs  |
| Evolution of filmmaking – Transition from linear to non-linear editing – Digital video concepts – Frame rates,aspect ratios, codecs, containers – Economy of expression – Ethics of editing – Risks associated with alteringreality through editing – Introduction to contemporary video workflows – Overview ofdigital cinema and online video platforms.      |                                                                                                                                       |                       |                          |   |            |       |
| Unit-2                                                                                                                                                                                                                                                                                                                                                          | STORYTELLINGANDEDITINGTECHNIQUES                                                                                                      |                       |                          |   | C02        | 9Hrs  |
| Principles ofvisual storytelling – Narrative structures for digital media – Editing styles:jump cuts, match cuts,L-cuts,J-cuts, cutaways, dissolves, splitedits – Rhythmandpacing – Continuityediting – Storytellingforshort-form,socialmedia,andwebvideos–Managingresolutions(HD,4K,8K)– Mediamanagementandproxyworkflows.                                     |                                                                                                                                       |                       |                          |   |            |       |
| Unit-3                                                                                                                                                                                                                                                                                                                                                          | AUDIOANDVIDEOACQUISITION&POST-PRODUCTION                                                                                              |                       |                          |   | C03        | 9Hrs  |
| Capturing digital and analog video – Camera basics – Mobile filmmaking techniques – Importing audio andvideo – Syncing audio – Basic sound design – Voice-over recording – Exporting and rendering formats– Delivery for broadcast, web, and streaming platforms – Archiving and backup strategies.                                                             |                                                                                                                                       |                       |                          |   |            |       |
| Unit-4                                                                                                                                                                                                                                                                                                                                                          | NON-LINEAREDITINGTOOLSANDWORKFLOWS                                                                                                    |                       |                          |   | C04        | 9Hrs  |
| Workingwith clips,timelines, and sequences – Basic and advanced editing techniques – Transitions and effects– Colorcorrectionandbasiccolorgrading – Workingwithaudiotracks – Titlesandcaptions – Media organization and preferences – Introduction to modern NLE tools:Final Cut Pro-Adobe PremierePro-DaVinciResolve                                           |                                                                                                                                       |                       |                          |   |            |       |
| Unit-5                                                                                                                                                                                                                                                                                                                                                          | ADVANCEDPOST-PRODUCTIONANDEMERGINGTECHNOLOGIES                                                                                        |                       |                          |   | C05        | 9Hrs  |
| Motion graphics and visual effects basics– Introduction tocompositing– AI-assistedediting tools(autocuts,noise reduction, upscaling) – Multicam editing – Sound mixing and mastering – Exporting forOTT platforms –Basicsof VR/360° video–Introduction tolivestreaming workflows– Ethicsandcopyrightissuesindigitalvideo – Career pathways in video production. |                                                                                                                                       |                       |                          |   |            |       |
|                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                       |                       |                          |   | TotalHours | 45Hrs |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                       |                       |                          |   |            |       |
| 1                                                                                                                                                                                                                                                                                                                                                               | KeithUnderdahl, “DigitalVideoforDummies”, ThirdEdition, DummySeries,2001.                                                             |                       |                          |   |            |       |
| 2                                                                                                                                                                                                                                                                                                                                                               | RobertM.GoodmanandPartickMcGarth,“EditingDigitalVideo:TheCompleteCreativeand TechnicalGuide”, DigitalVideoandAudio, McGraw – Hill2003 |                       |                          |   |            |       |

| Reference Books: |                                                                                                                                                                                           |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                | Wallace Jackson, Digital Video Editing Fundamentals, Apress.                                                                                                                              |
| 2                | Walter Murch, In the Blink of an Eye: A Perspective on Film Editing, Silman-James Press.                                                                                                  |
| 3                | Stu Maschwitz, The DV Rebel's Guide, Peachpit Press.                                                                                                                                      |
| Web References:  |                                                                                                                                                                                           |
| 1                | <a href="https://digitalnz.org/make-it-digital/creating-digital-content/creating-digital-video">https://digitalnz.org/make-it-digital/creating-digital-content/creating-digital-video</a> |
| 2                | <a href="https://www.agitraining.com/">https://www.agitraining.com/</a>                                                                                                                   |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 20%                   |                | 20%                  |            |            |                          |
| Apply                                                       | 80%                   | 100%           | 80%                  |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 marks.
- Experiment wise laboratory completion 10 marks and Model lab exam will be conducted for 100 marks and the same will be converted to 10 marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C502.1      | 2    | 2    | –    | –    | 1    | –    | –    | 2    | –    | –     | –     | 1     | –     |
| C502.2      | 2    | 2    | 3    | –    | 2    | –    | –    | –    | 2    | 3     | –     | 2     | 1     |
| C502.3      | 2    | 2    | 3    | 1    | 3    | –    | –    | –    | 2    | 3     | –     | 3     | 2     |
| C502.4      | 2    | 2    | 3    | 1    | 3    | –    | –    | –    | 2    | 2     | –     | 3     | 2     |
| C502.5      | 2    | 3    | 2    | 2    | 2    | –    | 1    | 1    | –    | 1     | –     | 2     | 3     |

1-low, 2-medium, 3-high, '–' - no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                    | Course Name                                                                                                                                                                                                       | Category               | Hours/Week                |   |   | C    |   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|---|
|                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                   |                        | L                         | T | P |      |   |
| 24AM503                                                                                                                                                                                                                                                                                                                                        | DIGITAL MARKETING                                                                                                                                                                                                 | PE                     | 3                         | 0 | 0 | 3    |   |
| Regulation                                                                                                                                                                                                                                                                                                                                     | Nature of the Course                                                                                                                                                                                              | Semester               | Data Book/Codes/Standards |   |   |      |   |
| 2024                                                                                                                                                                                                                                                                                                                                           | THEORY                                                                                                                                                                                                            | -                      | -                         |   |   |      |   |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                   | Co-requisite Course(s) |                           |   |   |      |   |
| Nil                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                   | Nil                    |                           |   |   |      |   |
| Course Objectives                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                              | To Understand the fundamentals and importance of digital marketing in modern business.                                                                                                                            |                        |                           |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                                                              | To Learn the concepts of search engine optimization (SEO) and search engine marketing (SEM).                                                                                                                      |                        |                           |   |   |      |   |
| 3                                                                                                                                                                                                                                                                                                                                              | To Apply social media and content marketing strategies.                                                                                                                                                           |                        |                           |   |   |      |   |
| 4                                                                                                                                                                                                                                                                                                                                              | To Apply email marketing and online advertising techniques                                                                                                                                                        |                        |                           |   |   |      |   |
| 5                                                                                                                                                                                                                                                                                                                                              | To Analyze digital marketing performance using analytics tools.                                                                                                                                                   |                        |                           |   |   |      |   |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| C504.1                                                                                                                                                                                                                                                                                                                                         | Understand digital marketing concepts and tools.                                                                                                                                                                  |                        |                           |   |   | [U]  |   |
| C504.2                                                                                                                                                                                                                                                                                                                                         | Implement SEO and search engine marketing strategies.                                                                                                                                                             |                        |                           |   |   | [AP] |   |
| C504.3                                                                                                                                                                                                                                                                                                                                         | Develop social media marketing campaigns.                                                                                                                                                                         |                        |                           |   |   | [AP] |   |
| C504.4                                                                                                                                                                                                                                                                                                                                         | Apply email marketing and online advertising techniques.                                                                                                                                                          |                        |                           |   |   | [AP] |   |
| C504.5                                                                                                                                                                                                                                                                                                                                         | Analyze digital marketing performance using analytics tools.                                                                                                                                                      |                        |                           |   |   | [AN] |   |
| Course Contents Hrs                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| Unit-1                                                                                                                                                                                                                                                                                                                                         | FUNDAMENTALS OF DIGITAL MARKETING                                                                                                                                                                                 |                        |                           |   |   | C01  | 9 |
| Introduction to Marketing and Digital Marketing, Traditional Marketing vs Digital Marketing, Digital Marketing Ecosystem, Online Consumer Behaviour, Digital Marketing Channels: Search Engines, Social Media, Email, Mobile Marketing. Website planning and development, Content marketing fundamentals, Digital marketing strategy framework |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| Unit-2                                                                                                                                                                                                                                                                                                                                         | SEARCH ENGINE OPTIMIZATION (SEO) & SEARCH MARKETING                                                                                                                                                               |                        |                           |   |   | C02  | 9 |
| Search engines and their working, Keyword research techniques, On-page SEO: Metatags, Title tags, Internal linking. Off-page SEO: Backlinks, Directory submissions, Social bookmarking. Technical SEO, Search Engine Marketing (SEM), Pay-Per-Click (PPC) advertising, Google Ads basics                                                       |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| Unit-3                                                                                                                                                                                                                                                                                                                                         | SOCIAL MEDIA & CONTENT MARKETING                                                                                                                                                                                  |                        |                           |   |   | C03  | 9 |
| Social media platform overview: Facebook, Instagram, LinkedIn, YouTube, Twitter. Social media marketing strategy, Content creation and storytelling, Blogging and microblogging, Influencer marketing, Online reputation management, Social media advertising                                                                                  |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| Unit-4                                                                                                                                                                                                                                                                                                                                         | EMAIL MARKETING & ONLINE ADVERTISING                                                                                                                                                                              |                        |                           |   |   | C04  | 9 |
| Email marketing fundamentals, Email campaign design, Email automation, Customer segmentation, Lead generation strategies, Display advertising, Affiliate marketing, Mobile marketing, Retargeting and remarketing                                                                                                                              |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| Unit-5                                                                                                                                                                                                                                                                                                                                         | DIGITAL MARKETING ANALYTICS & EMERGING TRENDS                                                                                                                                                                     |                        |                           |   |   | C05  | 9 |
| Web analytics fundamentals, Google Analytics overview, Conversion rate optimization (CRO), Marketing performance metrics: CTR, CPC, ROI. Conversion rate, Data-driven marketing decisions, Marketing automation tools, Artificial Intelligence in marketing, Future trends in digital marketing                                                |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| Total Hours                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                   |                        |                           |   |   | 45   |   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                              | Dave Chaffey and Fiona Ellis-Chadwick, Digital Marketing: Strategy, Implementation and Practice, 8th Edition, Pearson Education, 2022, ISBN: 978-1292400969.                                                      |                        |                           |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                                                              | Seema Gupta, Digital Marketing, 2nd Edition, McGraw Hill Education, 2023, ISBN: 978-9355324245.                                                                                                                   |                        |                           |   |   |      |   |
| 3                                                                                                                                                                                                                                                                                                                                              | Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns, 1st Edition, John Wiley & Sons (Wiley Publications), 2016, ISBN: 978-1119265702. |                        |                           |   |   |      |   |
| Reference Books:                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                              | Philip Kotler, Hermawan Kartajaya and Iwan Setiawan, Marketing 4.0: Moving from Traditional to Digital, 1st Edition, John Wiley & Sons (Wiley), 2017, ISBN: 978-1119341208.                                       |                        |                           |   |   |      |   |

|   |                                                                                                                                                                                                          |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | Ryan Deiss and Russ Henneberry, Digital Marketing for Dummies, 2nd Edition, Wiley, 2020, ISBN: 978-1119660484.                                                                                           |
| 3 | Joe Pulizzi, Epic Content Marketing: How to Tell a Different Story, Break Through the Clutter, and Win More Customers by Marketing Less, 2nd Edition, McGraw Hill Education, 2014, ISBN: 978-0071819893. |

**Web References:**

|   |                                                                                                                                                                                                         |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <a href="https://nptel.ac.in/courses/110105920">https://nptel.ac.in/courses/110105920</a>                                                                                                               |
| 2 | <a href="https://swayam.gov.in/search_courses?searchText=digital%20marketing">https://swayam.gov.in/search_courses?searchText=digital%20marketing</a>                                                   |
| 3 | <a href="https://skillshop.exceedlms.com/student/catalog/list?category_ids=7879-google-digital-garage">https://skillshop.exceedlms.com/student/catalog/list?category_ids=7879-google-digital-garage</a> |

**Assessment based on Continuous and End Semester Examination**

| BLOOM'S TAXONOMY LEVEL   | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|--------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
|                          | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                 |                       |                |                      | 10         | 10         | 60                       |
| Understand               | 80                    | 20             | 20                   |            |            |                          |
| Apply                    | 20                    | 80             | 80                   |            |            |                          |
| Analyze                  |                       |                |                      |            |            |                          |
| Evaluate                 |                       |                |                      |            |            |                          |
| Create                   |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PS01 | PS02 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|------|------|
| C504.1      | 3    | 2    | -    | -    | -    | -    | -    | -    | -    | -     | -     | 1    | 2    |
| C504.2      | 3    | 3    | 2    | -    | 2    | -    | -    | -    | -    | -     | 3     | 2    | 2    |
| C504.3      | 2    | 3    | 3    | -    | 2    | -    | -    | -    | 2    | 2     | 3     | 1    | 2    |
| C504.4      | 2    | 2    | 3    | -    | 2    | -    | -    | -    | 2    | 2     | -     | 1    | 2    |
| C504.5      | 3    | 3    | 2    | 2    | 3    | -    | -    | -    | -    | 2     | 3     | 2    | 3    |

1-low, 2-medium, 3-high, '-'-no correlation

**VERTICALV  
LANGUAGEMODELLING**

| Course Code                                                                                                                                                                                                                                                                                                            | Course Name                                                                                                 | Category               | Hours/Week                |   |   | C  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----|
|                                                                                                                                                                                                                                                                                                                        |                                                                                                             |                        | L                         | T | P |    |
| 24AM506                                                                                                                                                                                                                                                                                                                | LINGUISTIC ENGINEERING                                                                                      | PE                     | 3                         | 0 | 0 | 3  |
| Regulation                                                                                                                                                                                                                                                                                                             | Nature of the Course                                                                                        | Semester               | Data Book/Codes/Standards |   |   |    |
| R24                                                                                                                                                                                                                                                                                                                    | THEORY                                                                                                      | -                      | -----                     |   |   |    |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                |                                                                                                             | Co-requisite Course(s) |                           |   |   |    |
| -                                                                                                                                                                                                                                                                                                                      |                                                                                                             | -                      |                           |   |   |    |
| Course Objectives                                                                                                                                                                                                                                                                                                      |                                                                                                             |                        |                           |   |   |    |
| 1                                                                                                                                                                                                                                                                                                                      | To understand the fundamentals of linguistics and computational linguistics.                                |                        |                           |   |   |    |
| 2                                                                                                                                                                                                                                                                                                                      | To learn lexical, syntactic and semantic analysis techniques used in language processing.                   |                        |                           |   |   |    |
| 3                                                                                                                                                                                                                                                                                                                      | To apply statistical and machine learning approaches in natural language processing.                        |                        |                           |   |   |    |
| 4                                                                                                                                                                                                                                                                                                                      | To implement language models and text processing techniques.                                                |                        |                           |   |   |    |
| 5                                                                                                                                                                                                                                                                                                                      | To develop AI based language applications such as chatbots, translation and sentiment analysis.             |                        |                           |   |   |    |
| Course Outcomes                                                                                                                                                                                                                                                                                                        |                                                                                                             |                        |                           |   |   |    |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                |                                                                                                             |                        |                           |   |   |    |
| C506.1                                                                                                                                                                                                                                                                                                                 | Explain linguistic concepts and structure of natural language                                               |                        |                           |   |   | U  |
| C506.2                                                                                                                                                                                                                                                                                                                 | Apply lexical and syntactic processing techniques                                                           |                        |                           |   |   | AP |
| C506.3                                                                                                                                                                                                                                                                                                                 | Implement semantic analysis and language models                                                             |                        |                           |   |   | AP |
| C506.4                                                                                                                                                                                                                                                                                                                 | Analyze NLP techniques using machine learning methods                                                       |                        |                           |   |   | AN |
| C506.5                                                                                                                                                                                                                                                                                                                 | Develop AI-based language applications                                                                      |                        |                           |   |   | AP |
| Course Contents                                                                                                                                                                                                                                                                                                        |                                                                                                             |                        |                           |   |   |    |
| Unit -1                                                                                                                                                                                                                                                                                                                | FUNDAMENTALS OF LINGUISTICS AND NLP                                                                         |                        |                           |   |   | 9  |
| Introduction to Linguistic Engineering – Natural Language vs Formal Language – Applications of NLP – Levels of Language Analysis – Morphology – Phonology – Syntax – Semantics – Pragmatics – Corpus Linguistics – Text Corpora and Annotation – Overview of NLP pipeline – Challenges in Natural Language Processing. |                                                                                                             |                        |                           |   |   |    |
| Unit -2                                                                                                                                                                                                                                                                                                                | LEXICAL ANALYSIS AND MORPHOLOGY                                                                             |                        |                           |   |   | 9  |
| Word structure and morphology – Tokenization – Stemming and Lemmatization – Stop word removal – Regular expressions in NLP – Finite State Automata for morphology – Part of Speech (POS) tagging – Rule-based and statistical POS tagging – N-gram models – Language modeling basics.                                  |                                                                                                             |                        |                           |   |   |    |
| Unit -3                                                                                                                                                                                                                                                                                                                | SYNTACTIC ANALYSIS                                                                                          |                        |                           |   |   | 9  |
| Context Free Grammar (CFG) – Parsing techniques – Top-down parsing – Bottom-up parsing – Chart parsing – Dependency parsing – Treebanks – Syntactic ambiguity – Parsing algorithms – Applications of syntactic analysis.                                                                                               |                                                                                                             |                        |                           |   |   |    |
| Unit -4                                                                                                                                                                                                                                                                                                                | SEMANTIC AND DISCOURSE PROCESSING                                                                           |                        |                           |   |   | 9  |
| Semantic representation – First order predicate logic – Word sense disambiguation – Semantic role labeling – Named Entity Recognition – Coreference resolution – Discourse analysis – Pragmatic processing – Information extraction techniques.                                                                        |                                                                                                             |                        |                           |   |   |    |
| Unit -5                                                                                                                                                                                                                                                                                                                | MACHINE LEARNING FOR NLP APPLICATIONS                                                                       |                        |                           |   |   | 9  |
| Text classification – Sentiment analysis – Topic modeling – Information retrieval basics – Machine learning techniques in NLP – Deep learning for NLP – Word embeddings – Transformers and language models – Chatbots – Machine translation – Question answering systems.                                              |                                                                                                             |                        |                           |   |   |    |
| Total Hours                                                                                                                                                                                                                                                                                                            |                                                                                                             |                        |                           |   |   | 45 |
| Textbooks:                                                                                                                                                                                                                                                                                                             |                                                                                                             |                        |                           |   |   |    |
| 1                                                                                                                                                                                                                                                                                                                      | Daniel Jurafsky and James H. Martin, Speech and Language Processing, Pearson Education.                     |                        |                           |   |   |    |
| 2                                                                                                                                                                                                                                                                                                                      | James Allen, Natural Language Understanding, Pearson.                                                       |                        |                           |   |   |    |
| Reference Books:                                                                                                                                                                                                                                                                                                       |                                                                                                             |                        |                           |   |   |    |
| 1                                                                                                                                                                                                                                                                                                                      | Christopher Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing, MIT Press. |                        |                           |   |   |    |
| 2                                                                                                                                                                                                                                                                                                                      | Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, O'Reilly.                   |                        |                           |   |   |    |

|   |                                                                                  |
|---|----------------------------------------------------------------------------------|
| 3 | YoavGoldberg, NeuralNetworkMethods inNaturalLanguageProcessing, Morgan&Claypool. |
| 4 | Jacob Eisenstein, Introduction to Natural Language Processing, MIT Press.        |

| AssessmentbasedonContinuousandEndSemesterExamination |                      |               |                    |            |            |                         |
|------------------------------------------------------|----------------------|---------------|--------------------|------------|------------|-------------------------|
| Bloom's Level                                        | CONTINUOUSASSESSMENT |               |                    | ASSIGNMENT | ATTENDANCE | ENDSEMESTER EXAMINATION |
|                                                      | CIA1 (6Marks)        | CIA2 (6Marks) | ModelExam (8Marks) |            |            |                         |
| Remember                                             |                      |               |                    | (10Marks)  | (10Marks)  | (60Marks)               |
| Understand                                           | 80%                  | 20%           | 20%                |            |            |                         |
| Apply                                                | 20%                  | 80%           | 80%                |            |            |                         |
| Analyze                                              |                      |               |                    |            |            |                         |
| Evaluate                                             |                      |               |                    |            |            |                         |
| Create                                               |                      |               |                    |            |            |                         |
| <b>Total (100Marks)</b>                              | <b>6</b>             | <b>6</b>      | <b>8</b>           | <b>10</b>  | <b>10</b>  | <b>60</b>               |

• CIA1, CIA2andModelExamwillbeconductedfor50,50and100marks.Itshallbe subsequently converted to 6, 6 and 8 marks respectively.

• TheAssignmentmarkswillbecomputedbasedonAssignmentI, AssignmentIIandAssignmentIIImarksconvertedto10 Marks.

• BTL mark split up may vary based on thenatureofthesubject.

| COs/<br>POs | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P010 | P011 | PS01 | PS02 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C506.1      | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | 2    | -    | 3    |
| C506.2      | 3   | 3   | 2   | -   | 2   | -   | -   | -   | -   | -    | 2    | -    | 3    |
| C506.3      | 3   | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -    | 2    | -    | 3    |
| C506.4      | 3   | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -    | 2    | -    | 3    |
| C506.5      | 3   | 2   | 3   | 2   | 3   | -   | -   | -   | -   | -    | 2    | -    | 3    |

**3-Strong2-Moderate1-Weak--nocorrelation**

| Course Code                                                                                                                                                                                                                                                            | Course Name                                                                                                                               | Category                             | Hours/Week                            |   |   | C               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|---------------------------------------|---|---|-----------------|
|                                                                                                                                                                                                                                                                        |                                                                                                                                           |                                      | L                                     | T | P |                 |
| 24AM507                                                                                                                                                                                                                                                                | SOFT COMPUTING                                                                                                                            | PE                                   | 3                                     | 0 | 0 | 3               |
| <b>Regulation</b><br>R24                                                                                                                                                                                                                                               | <b>Nature of the Course</b><br>THEORY                                                                                                     | <b>Semester</b><br>-                 | <b>Data Book/Codes/Standards</b><br>- |   |   |                 |
| <b>Pre-requisite Course(s)</b><br>Artificial Intelligence                                                                                                                                                                                                              |                                                                                                                                           | <b>Co-requisite Course(s)</b><br>Nil |                                       |   |   |                 |
| <b>Course Objectives</b>                                                                                                                                                                                                                                               |                                                                                                                                           |                                      |                                       |   |   |                 |
| 1                                                                                                                                                                                                                                                                      | To understand the fundamental concepts of soft computing and its components such as neural networks, fuzzy logic, and genetic algorithms. |                                      |                                       |   |   |                 |
| 2                                                                                                                                                                                                                                                                      | To study the structure and learning mechanisms of artificial neural networks and their applications.                                      |                                      |                                       |   |   |                 |
| 3                                                                                                                                                                                                                                                                      | To learn the principles of fuzzy logic and apply fuzzy systems to solve real-world problems.                                              |                                      |                                       |   |   |                 |
| 4                                                                                                                                                                                                                                                                      | To understand the working of genetic algorithms and their use in optimization problems.                                                   |                                      |                                       |   |   |                 |
| 5                                                                                                                                                                                                                                                                      | To explore hybrid soft computing techniques and their applications in various domains.                                                    |                                      |                                       |   |   |                 |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                 |                                                                                                                                           |                                      |                                       |   |   |                 |
| <b>Upon completion of the course, students will be able to</b>                                                                                                                                                                                                         |                                                                                                                                           |                                      |                                       |   |   |                 |
| C507.1                                                                                                                                                                                                                                                                 | Understand the basic concepts and components of soft computing.                                                                           |                                      |                                       |   |   | [U]             |
| C507.2                                                                                                                                                                                                                                                                 | Explain the structure and working of artificial neural networks.                                                                          |                                      |                                       |   |   | [U]             |
| C507.3                                                                                                                                                                                                                                                                 | Apply fuzzy logic concepts to solve simple problems.                                                                                      |                                      |                                       |   |   | [AP]            |
| C507.4                                                                                                                                                                                                                                                                 | Analyze genetic algorithms and their operations.                                                                                          |                                      |                                       |   |   | [U]             |
| C507.5                                                                                                                                                                                                                                                                 | Evaluate hybrid soft computing techniques and their applications.                                                                         |                                      |                                       |   |   | [AP]            |
| <b>Course Contents</b>                                                                                                                                                                                                                                                 |                                                                                                                                           |                                      |                                       |   |   |                 |
| <b>Unit-1</b>                                                                                                                                                                                                                                                          | INTRODUCTION TO SOFT COMPUTING                                                                                                            |                                      |                                       |   |   | <b>C01 9Hrs</b> |
| Introduction to Soft Computing – Difference between Soft Computing and Hard Computing – Applications of Soft Computing – Components of Soft Computing – Neural Networks – Fuzzy Logic – Genetic Algorithms – Hybrid Systems – Advantages of Soft Computing Techniques. |                                                                                                                                           |                                      |                                       |   |   |                 |
| <b>Unit-2</b>                                                                                                                                                                                                                                                          | ARTIFICIAL NEURAL NETWORKS                                                                                                                |                                      |                                       |   |   | <b>C02 9Hrs</b> |
| Biological Neural Network – Artificial Neuron Model – Neural Network Architecture – Activation Functions – Learning Methods – Supervised Learning – Unsupervised Learning – Single Layer Perceptron – Multi Layer Perceptron – Applications of Neural Networks.        |                                                                                                                                           |                                      |                                       |   |   |                 |
| <b>Unit-3</b>                                                                                                                                                                                                                                                          | FUZZY LOGIC                                                                                                                               |                                      |                                       |   |   | <b>C03 9Hrs</b> |
| Introduction to Fuzzy Logic – Crisp Sets and Fuzzy Sets – Membership Functions – Fuzzy Operations – Fuzzy Rules – Fuzzy Inference System – Defuzzification Methods – Applications of Fuzzy Logic in Control Systems.                                                   |                                                                                                                                           |                                      |                                       |   |   |                 |
| <b>Unit-4</b>                                                                                                                                                                                                                                                          | GENETIC ALGORITHMS                                                                                                                        |                                      |                                       |   |   | <b>C04 9Hrs</b> |
| Introduction to Genetic Algorithms – Basic Concepts – Genetic Representation – Fitness Function – Selection Methods – Crossover Operation – Mutation Operation – Genetic Algorithm Cycle – Applications of Genetic Algorithms.                                         |                                                                                                                                           |                                      |                                       |   |   |                 |
| <b>Unit-5</b>                                                                                                                                                                                                                                                          | HYBRID SYSTEMS AND APPLICATIONS                                                                                                           |                                      |                                       |   |   | <b>C05 9Hrs</b> |
| Neuro-Fuzzy Systems – Genetic Neural Networks – Hybrid Soft Computing Techniques – Applications of Soft Computing in Pattern Recognition – Image Processing – Optimization Problems – Data Mining – Future Trends in Soft Computing.                                   |                                                                                                                                           |                                      |                                       |   |   |                 |
| <b>Total Hours</b>                                                                                                                                                                                                                                                     |                                                                                                                                           |                                      |                                       |   |   | <b>45</b>       |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                      |                                                                                                                                           |                                      |                                       |   |   |                 |
| 1                                                                                                                                                                                                                                                                      | S. Rajasekaran & G.A. Vijayalakshmi Pai, <b>Neural Networks, Fuzzy Logic and Genetic Algorithms</b> , PHI.                                |                                      |                                       |   |   |                 |
| 2                                                                                                                                                                                                                                                                      | S. N. Sivanandam & S. N. Deepa, <b>Principles of Soft Computing</b> , Wiley.                                                              |                                      |                                       |   |   |                 |
| 3                                                                                                                                                                                                                                                                      | Timothy J. Ross, <b>Fuzzy Logic with Engineering Applications</b> , Wiley.                                                                |                                      |                                       |   |   |                 |
| <b>Reference Books:</b>                                                                                                                                                                                                                                                |                                                                                                                                           |                                      |                                       |   |   |                 |
| 1                                                                                                                                                                                                                                                                      | David E. Goldberg, <b>Genetic Algorithms in Search, Optimization and Machine Learning</b> , Addison Wesley.                               |                                      |                                       |   |   |                 |
| 2                                                                                                                                                                                                                                                                      | Jang, Sun & Mizutani, <b>Neuro-Fuzzy and Soft Computing</b> , PHI Learning Pvt. Ltd., 2003                                                |                                      |                                       |   |   |                 |
| 3                                                                                                                                                                                                                                                                      | Simon Haykin, <b>Neural Networks and Learning Machines</b> , Pearson.                                                                     |                                      |                                       |   |   |                 |
| 4                                                                                                                                                                                                                                                                      | George J. Klir & Bo Yuan, <b>Fuzzy Sets and Fuzzy Logic: Theory and Application</b> , Prentice Hall.                                      |                                      |                                       |   |   |                 |
| <b>Web References:</b>                                                                                                                                                                                                                                                 |                                                                                                                                           |                                      |                                       |   |   |                 |
| 1                                                                                                                                                                                                                                                                      | <a href="https://nptel.ac.in/courses/106105173">https://nptel.ac.in/courses/106105173</a>                                                 |                                      |                                       |   |   |                 |
| 2                                                                                                                                                                                                                                                                      | <a href="https://swayam.gov.in">https://swayam.gov.in</a>                                                                                 |                                      |                                       |   |   |                 |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| BLOOM'S<br>TAXONOMY<br>LEVEL                                | CONTINUOUS ASSESSMENT |                   |                         | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                   |                         |            |            |                          |
| Understand                                                  | 80                    | 20                | 20                      |            |            |                          |
| Apply                                                       | 20                    | 80                | 80                      |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total<br/>(100 Marks)</b>                                | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PSO<br>2 | PSO<br>3 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|
| C507.1      | 3       | 2       | -       | -       | -       | -       | -       | -       | -       | -        | 1        | 2        | 1        | -        |
| C507.2      | 3       | 3       | 2       | -       | -       | -       | -       | -       | -       | -        | 1        | 3        | 2        | -        |
| C507.3      | 3       | 3       | 3       | 2       | -       | -       | -       | -       | -       | -        | 2        | 3        | 2        | 1        |
| C507.4      | 3       | 3       | 2       | 2       | 1       | -       | -       | -       | -       | -        | 2        | 3        | 2        | 1        |
| C507.5      | 3       | 3       | 3       | 2       | 2       | -       | -       | -       | -       | -        | 2        | 3        | 3        | 2        |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                     | Course Name                                                                                                                     | Category                   | Hours/Week                  |   |   | C        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|----------------------------|-----------------------------|---|---|----------|
|                                                                                                                                                                                                                                                 |                                                                                                                                 |                            | L                           | T | P |          |
| 24AM508                                                                                                                                                                                                                                         | COGNITIVE SCIENCE                                                                                                               | PE                         | 3                           | 0 | 0 | 3        |
| Regulation R24                                                                                                                                                                                                                                  | Nature of the Course THEORY                                                                                                     | Semester -                 | Data Book/Codes/Standards - |   |   |          |
| Pre-requisite Course(s) ARTIFICIAL INTELLIGENCE                                                                                                                                                                                                 |                                                                                                                                 | Co-requisite Course(s) Nil |                             |   |   |          |
| Course Objectives                                                                                                                                                                                                                               |                                                                                                                                 |                            |                             |   |   |          |
| 1                                                                                                                                                                                                                                               | Understand the basic concepts and interdisciplinary nature of cognitive science.                                                |                            |                             |   |   |          |
| 2                                                                                                                                                                                                                                               | Understand cognitive processes such as perception, memory, and problem solving.                                                 |                            |                             |   |   |          |
| 3                                                                                                                                                                                                                                               | Understand the structure and functions of the human brain related to cognition.                                                 |                            |                             |   |   |          |
| 4                                                                                                                                                                                                                                               | Apply computational models and artificial intelligence techniques in cognitive science.                                         |                            |                             |   |   |          |
| 5                                                                                                                                                                                                                                               | Apply cognitive science concepts in language processing and real-world applications.                                            |                            |                             |   |   |          |
| Course Outcomes                                                                                                                                                                                                                                 |                                                                                                                                 |                            |                             |   |   |          |
| Upon completion of the course, students will be able to                                                                                                                                                                                         |                                                                                                                                 |                            |                             |   |   |          |
| C508.1                                                                                                                                                                                                                                          | Explain the fundamental concepts and interdisciplinary aspects of cognitive science.                                            |                            |                             |   |   | [U]      |
| C508.2                                                                                                                                                                                                                                          | Describe various cognitive processes such as attention, perception, and memory.                                                 |                            |                             |   |   | [U]      |
| C508.3                                                                                                                                                                                                                                          | Illustrate the role of the human brain and neural mechanisms in cognition.                                                      |                            |                             |   |   | [U]      |
| C508.4                                                                                                                                                                                                                                          | Apply computational models and reasoning techniques to simulate cognitive processes.                                            |                            |                             |   |   | [AP]     |
| C508.5                                                                                                                                                                                                                                          | Demonstrate the use of cognitive science principles in real-world applications such as AI and human-computer interaction.       |                            |                             |   |   | [AP]     |
| Course Contents                                                                                                                                                                                                                                 |                                                                                                                                 |                            |                             |   |   |          |
| Unit-1                                                                                                                                                                                                                                          | INTRODUCTION TO COGNITIVE SCIENCE                                                                                               |                            |                             |   |   | C01 9Hrs |
| Introduction to Cognitive Science – Interdisciplinary Nature – Relationship between Psychology, AI, Neuroscience, Linguistics and Philosophy – Human Cognition – Information Processing – Perception – Learning – Memory – Language Processing. |                                                                                                                                 |                            |                             |   |   |          |
| Unit-2                                                                                                                                                                                                                                          | COGNITIVE PSYCHOLOGY                                                                                                            |                            |                             |   |   | C02 9Hrs |
| Cognitive Psychology – Attention – Perception – Memory – Problem Solving – Decision Making – Representation of Knowledge – Cognitive Architecture – Information Processing Models.                                                              |                                                                                                                                 |                            |                             |   |   |          |
| Unit-3                                                                                                                                                                                                                                          | COGNITIVE NEUROSCIENCE                                                                                                          |                            |                             |   |   | C03 9Hrs |
| Brain and Cognition – Structure and Function of Nervous System – Neurons – Brain Mapping Techniques – Neural Representation – Cognitive Functions of Brain – Neuroplasticity – Case Studies.                                                    |                                                                                                                                 |                            |                             |   |   |          |
| Unit-4                                                                                                                                                                                                                                          | COMPUTATIONAL MODELS OF COGNITION                                                                                               |                            |                             |   |   | C04 9Hrs |
| Artificial Intelligence and Cognition – Knowledge Representation – Logical Reasoning – Inference Models – Probabilistic Models – Machine Learning Basics – Cognitive Architectures.                                                             |                                                                                                                                 |                            |                             |   |   |          |
| Unit-5                                                                                                                                                                                                                                          | LANGUAGE AND APPLICATIONS OF COGNITIVE SCIENCE                                                                                  |                            |                             |   |   | C05 9Hrs |
| Language Acquisition – Semantics – Cognitive Models of Language Processing – Applications in AI – Pattern Recognition – Human-Computer Interaction – Cognitive Systems – Future Trends.                                                         |                                                                                                                                 |                            |                             |   |   |          |
| Total Hours                                                                                                                                                                                                                                     |                                                                                                                                 |                            |                             |   |   | 45       |
| Textbooks:                                                                                                                                                                                                                                      |                                                                                                                                 |                            |                             |   |   |          |
| 1                                                                                                                                                                                                                                               | Margaret W. Matlin, <b>Cognition</b> , Wiley.                                                                                   |                            |                             |   |   |          |
| 2                                                                                                                                                                                                                                               | José Luis Bermúdez, <b>Cognitive Science: An Introduction to the Science of the Mind</b> , Cambridge University Press.          |                            |                             |   |   |          |
| 3                                                                                                                                                                                                                                               | Paul Thagard, <b>Mind: Introduction to Cognitive Science</b> , MIT Press.                                                       |                            |                             |   |   |          |
| Reference Books:                                                                                                                                                                                                                                |                                                                                                                                 |                            |                             |   |   |          |
| 1                                                                                                                                                                                                                                               | Jay Friedenberg & Gordon Silverman, <b>Cognitive Science: An Introduction to the Study of Mind</b> , Sage Publications.         |                            |                             |   |   |          |
| 2                                                                                                                                                                                                                                               | Daniel Reisberg, <b>Cognition: Exploring the Science of the Mind</b> , W.W. Norton.                                             |                            |                             |   |   |          |
| 3                                                                                                                                                                                                                                               | Michael S. Gazzaniga, Richard B. Ivry & George R. Mangun, <b>Cognitive Neuroscience: The Biology of the Mind</b> , W.W. Norton. |                            |                             |   |   |          |
| 4                                                                                                                                                                                                                                               | E. Bruce Goldstein, <b>Cognitive Psychology: Connecting Mind, Research, and Everyday Experience</b> , Cengage Learning.         |                            |                             |   |   |          |
| Web References:                                                                                                                                                                                                                                 |                                                                                                                                 |                            |                             |   |   |          |
| 1                                                                                                                                                                                                                                               | <a href="https://nptel.ac.in">https://nptel.ac.in</a>                                                                           |                            |                             |   |   |          |
| 2                                                                                                                                                                                                                                               | <a href="https://swayam.gov.in">https://swayam.gov.in</a>                                                                       |                            |                             |   |   |          |
| 3                                                                                                                                                                                                                                               | <a href="https://ocw.mit.edu">https://ocw.mit.edu</a>                                                                           |                            |                             |   |   |          |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 80                    | 80             | 20                   |            |            |                          |
| Apply                                                       | 20                    | 20             | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| C0s/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C508.1      | 3    | 2    | -    | -    | -    | -    | -    | -    | -    | -     | 1     | 2     | 1     | -     |
| C508.2      | 3    | 3    | 2    | -    | -    | -    | -    | -    | -    | -     | 1     | 3     | 2     | -     |
| C508.3      | 3    | 3    | 2    | 2    | -    | -    | -    | -    | -    | -     | 2     | 3     | 2     | 1     |
| C508.4      | 3    | 3    | 3    | 2    | 1    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 1     |
| C508.5      | 3    | 3    | 3    | 2    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                     | Course Name                                                                                                                                                                          | Category               | Hours/Week                |   |     | C    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-----|------|
|                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                      |                        | L                         | T | P   |      |
| 24AM509                                                                                                                                                                                                                                                                                                                         | ETHICAL HACKING                                                                                                                                                                      | PE                     | 3                         | 0 | 0   | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                      | Nature of the Course                                                                                                                                                                 | Semester               | Data Book/Codes/Standards |   |     |      |
| 2024                                                                                                                                                                                                                                                                                                                            | THEORY                                                                                                                                                                               | -                      | -                         |   |     |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                      | Co-requisite Course(s) |                           |   |     |      |
| OPERATING SYSTEMS                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                      | Nil                    |                           |   |     |      |
| Course Objectives                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                      |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                               | To understand the fundamentals of cyber security and ethical hacking.                                                                                                                |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                               | To identify vulnerabilities and security threats in computer networks and systems.                                                                                                   |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                               | To learn various hacking techniques and penetration testing methods.                                                                                                                 |                        |                           |   |     |      |
| 4                                                                                                                                                                                                                                                                                                                               | To analyze web application security vulnerabilities.                                                                                                                                 |                        |                           |   |     |      |
| 5                                                                                                                                                                                                                                                                                                                               | To understand security policies, cyber laws, and ethical practices.                                                                                                                  |                        |                           |   |     |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                      |                        |                           |   |     |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                         |                                                                                                                                                                                      |                        |                           |   |     |      |
| C509.1                                                                                                                                                                                                                                                                                                                          | Explain Cyber security principles and ethical hacking concepts.                                                                                                                      |                        |                           |   |     | [U]  |
| C509.2                                                                                                                                                                                                                                                                                                                          | Apply network scanning and vulnerability assessment techniques.                                                                                                                      |                        |                           |   |     | [AP] |
| C509.3                                                                                                                                                                                                                                                                                                                          | Analyze system security threats and malware attacks.                                                                                                                                 |                        |                           |   |     | [AN] |
| C509.4                                                                                                                                                                                                                                                                                                                          | Evaluate web application vulnerabilities and security mechanisms.                                                                                                                    |                        |                           |   |     | [AN] |
| C509.5                                                                                                                                                                                                                                                                                                                          | Perform penetration testing and implement security policies.                                                                                                                         |                        |                           |   |     | [AN] |
| Course Contents Hrs                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                      |                        |                           |   |     |      |
| Unit-1                                                                                                                                                                                                                                                                                                                          | FUNDAMENTALS OF ETHICAL HACKING                                                                                                                                                      |                        |                           |   | C01 | 9    |
| Introduction to Cyber Security and Ethical Hacking, Types of Hackers: White Hat, Black Hat, Grey Hat, Ethical Hacking Methodology and Phase, Cyber Threats and Vulnerabilities, Footprinting and Reconnaissance, Open Source Intelligence (OSINT), Information Gathering Techniques, Security Policies and Security Frameworks. |                                                                                                                                                                                      |                        |                           |   |     |      |
| Unit-2                                                                                                                                                                                                                                                                                                                          | NETWORK SCANNING AND VULNERABILITY ANALYSIS                                                                                                                                          |                        |                           |   | C02 | 9    |
| Network Scanning Techniques, Port Scanning and Network Mapping, Enumeration Techniques, Vulnerability Assessment and Risk Analysis, Packet Sniffing and Traffic Analysis, Intrusion Detection and Prevention Systems (IDS/IPS), Firewall Concepts and Network Security Protocols.                                               |                                                                                                                                                                                      |                        |                           |   |     |      |
| Unit-3                                                                                                                                                                                                                                                                                                                          | SYSTEM HACKING AND MALWARE ATTACKS                                                                                                                                                   |                        |                           |   | C03 | 9    |
| Password Cracking Techniques, Privilege Escalation, Malware Threats: Virus, Worms, Trojans, Ransomware, Rootkits and Backdoors, Keyloggers and Spyware, Steganography Concepts, System Security Countermeasures.                                                                                                                |                                                                                                                                                                                      |                        |                           |   |     |      |
| Unit-4                                                                                                                                                                                                                                                                                                                          | WEB APPLICATION HACKING                                                                                                                                                              |                        |                           |   | C04 | 9    |
| Web Application Architecture, Web Application Vulnerabilities, SQL Injection Attacks, Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), Session Hijacking and Cookie Attacks, Web Server Security, Secure Coding Practices.                                                                                        |                                                                                                                                                                                      |                        |                           |   |     |      |
| Unit-5                                                                                                                                                                                                                                                                                                                          | PENETRATION TESTING AND SECURITY MANAGEMENT                                                                                                                                          |                        |                           |   | C05 | 9    |
| Penetration Testing Methodology, Ethical Hacking Tools (Kali Linux, Nmap, Wireshark, Metasploit), Security Testing and Reporting, Incident Response and Risk Management, Digital Forensics Basics, Security Policies and Compliance, Cyber Laws and Ethical Issues.                                                             |                                                                                                                                                                                      |                        |                           |   |     |      |
| Total Theory Hours                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                      |                        |                           |   | 45  |      |
| Textbooks:                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                      |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                               | Michael T. Simpson, Kent Backman and James Corley, Hands-On Ethical Hacking and Network Defense, 3rd Edition, Cengage Learning, 2016, ISBN: 978-1305078420.                          |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                               | Patrick Engebretson, The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy, 2nd Edition, Syngress (Elsevier), 2013, ISBN: 978-0124116443. |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                               | Kimberly Graves, CEH Official Certified Ethical Hacker Review Guide, 3rd Edition, Wiley, 2021, ISBN: 978-1119800286.                                                                 |                        |                           |   |     |      |
| Reference Books:                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                      |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                               | Jon Erickson, Hacking: The Art of Exploitation, 2nd Edition, No Starch Press, 2008, ISBN: 978-1593271442.                                                                            |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                               | Kevin Mitnick and William L. Simon, The Art of Deception: Controlling the Human Element of Security, 1st Edition, Wiley, 2002, ISBN: 978-0764542800.                                 |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                               | Rafay Baloch, Ethical Hacking and Penetration Testing Guide, 1st Edition, CRC Press (Taylor & Francis), 2017, ISBN: 978-1138190238.                                                  |                        |                           |   |     |      |
| Web References:                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                      |                        |                           |   |     |      |

|   |                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------|
| 1 | <a href="https://nptel.ac.in/courses/106105217">https://nptel.ac.in/courses/106105217</a>                                   |
| 2 | <a href="https://owasp.org/search/?searchString=ethical+hacking">https://owasp.org/search/?searchString=ethical+hacking</a> |
| 3 | <a href="https://kali.org/">https://kali.org/</a>                                                                           |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| BLOOM'S<br>TAXONOMY<br>LEVEL                                | CONTINUOUS ASSESSMENT |                   |                         | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                   |                         | 10         | 10         | 60                       |
| Understand                                                  | 80                    | 20                | 20                      |            |            |                          |
| Apply                                                       | 20                    | 80                | 80                      |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total<br/>(100 Marks)</b>                                | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PSO<br>2 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|
| C509.1      | 3       | 2       | -       | -       | 1       | -       | -       | -       | -       | -        | 2        | 2        | 2        |
| C509.2      | 2       | 3       | 1       | 2       | 3       | -       | -       | -       | -       | -        | 2        | 2        | 3        |
| C509.3      | 2       | 3       | 1       | 2       | 2       | -       | -       | -       | -       | -        | 2        | 1        | 3        |
| C509.4      | 2       | 2       | 2       | 2       | 3       | -       | -       | -       | -       | -        | 2        | 1        | 3        |
| C509.5      | 3       | 2       | 2       | 2       | 3       | -       | -       | -       | -       | -        | 2        | 2        | 3        |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                         | Course Name                                                                                                                                                                                                                                 | Category               | Hours/Week                |   |   | C        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----------|
|                                                                                                                                                                                                     |                                                                                                                                                                                                                                             |                        | L                         | T | P |          |
| 24AM510                                                                                                                                                                                             | OPTIMIZATION TECHNIQUES                                                                                                                                                                                                                     | PE                     | 3                         | 0 | 0 | 3        |
| Regulation 2024                                                                                                                                                                                     | Nature of the Course                                                                                                                                                                                                                        | Semester               | Data Book/Codes/Standards |   |   |          |
|                                                                                                                                                                                                     | THEORY                                                                                                                                                                                                                                      | -                      | -                         |   |   |          |
| Pre-requisite Course(s)                                                                                                                                                                             |                                                                                                                                                                                                                                             | Co-requisite Course(s) |                           |   |   |          |
| Artificial Intelligence, Machine Learning                                                                                                                                                           |                                                                                                                                                                                                                                             | Deep learning          |                           |   |   |          |
| Course Objectives                                                                                                                                                                                   |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| 1                                                                                                                                                                                                   | To formulate linear programming problems (LPP)                                                                                                                                                                                              |                        |                           |   |   |          |
| 2                                                                                                                                                                                                   | To evaluate Integer Programming Problems, Transportation and Assignment Problems                                                                                                                                                            |                        |                           |   |   |          |
| 3                                                                                                                                                                                                   | To obtain a solution to network problems using CPM and PERT techniques                                                                                                                                                                      |                        |                           |   |   |          |
| 4                                                                                                                                                                                                   | To optimize the function subject to the constraints                                                                                                                                                                                         |                        |                           |   |   |          |
| 5                                                                                                                                                                                                   | To identify and solve problems under Markovian queuing models                                                                                                                                                                               |                        |                           |   |   |          |
| Course Outcomes                                                                                                                                                                                     |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| Upon completion of the course, students will be able to                                                                                                                                             |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| C510.1                                                                                                                                                                                              | Solve linear programming problems (LPP)                                                                                                                                                                                                     |                        |                           |   |   | [AP]     |
| C510.2                                                                                                                                                                                              | Evaluate Integer Programming Problems, Transportation and Assignment Problems                                                                                                                                                               |                        |                           |   |   | [AP]     |
| C510.3                                                                                                                                                                                              | Obtain a solution to network problems using CPM and PERT techniques                                                                                                                                                                         |                        |                           |   |   | [AN]     |
| C510.4                                                                                                                                                                                              | Able to optimize the function subject to the constraints                                                                                                                                                                                    |                        |                           |   |   | [AN]     |
| C510.5                                                                                                                                                                                              | Solve problems under Markovian queuing models                                                                                                                                                                                               |                        |                           |   |   | [AP]     |
| Course Contents                                                                                                                                                                                     |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| Unit-1                                                                                                                                                                                              | LINEAR MODELS                                                                                                                                                                                                                               |                        |                           |   |   | C01 9Hrs |
| Introduction of Operations Research - mathematical formulation of LPP - Graphical Method to solve LPP - Simplex Method - Two-Phase method.                                                          |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| Unit-2                                                                                                                                                                                              | INTEGER PROGRAMMING AND TRANSPORTATION PROBLEMS                                                                                                                                                                                             |                        |                           |   |   | C02 9Hrs |
| Integer programming: Branch and bound method - Transportation and Assignment problems - Traveling salesman problem.                                                                                 |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| Unit-3                                                                                                                                                                                              | PROJECT SCHEDULING                                                                                                                                                                                                                          |                        |                           |   |   | C03 9Hrs |
| Project network - Diagram representation - Floats - Critical path method (CPM) - PERT - Cost considerations in PERT and CPM.                                                                        |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| Unit-4                                                                                                                                                                                              | CLASSICAL OPTIMIZATION THEORY                                                                                                                                                                                                               |                        |                           |   |   | C04 9Hrs |
| Unconstrained problems - necessary and sufficient conditions - Newton-Raphson method, Constrained problems - equality constraints - inequality constraints - Kuhn-Tucker conditions.                |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| Unit-5                                                                                                                                                                                              | QUEUING MODELS                                                                                                                                                                                                                              |                        |                           |   |   | C05 9Hrs |
| Introduction, Queuing Theory, Operating characteristics of a Queuing system, Constituent of a Queuing system, Service facility, Queue discipline, Single channel models, multiple service channels. |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| Total Hours                                                                                                                                                                                         |                                                                                                                                                                                                                                             |                        |                           |   |   | 45       |
| Textbooks:                                                                                                                                                                                          |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| 1                                                                                                                                                                                                   | Edwin K.P. Chong, Stanislaw H. Zak, "An Introduction to Optimization: With Applications to Machine Learning", 5th Edition, Wiley, 2023                                                                                                      |                        |                           |   |   |          |
| 2                                                                                                                                                                                                   | Faiz Hamid, "Optimization Essentials: Theory, Tools, and Applications", Springer Nature, 2025.                                                                                                                                              |                        |                           |   |   |          |
| 3                                                                                                                                                                                                   | Dr. Alaa Khamis, "Optimization Algorithms: Al techniques for design, planning, and control problems", Manning Publications., 2024.                                                                                                          |                        |                           |   |   |          |
| Reference Books:                                                                                                                                                                                    |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| 1                                                                                                                                                                                                   | Alessandro Zocca, Jeffrey C. Kantor, Krzysztof Postek, Joaquim A. S. Gromicho, "Hands-On Mathematical Optimization with Python", Cambridge University Press, 2025.                                                                          |                        |                           |   |   |          |
| 2                                                                                                                                                                                                   | Debashish Das, Ali Safaa Sadiq, Seyedali Mirjalili, "Optimization Algorithms in Machine Learning: A Meta-heuristics Perspective", Springer Singapore, 2025.                                                                                 |                        |                           |   |   |          |
| 3                                                                                                                                                                                                   | Anton Ereemev, et al, "Mathematical Optimization Theory and Operations Research: Recent Trends ", Springer Nature Switzerland, 2024.                                                                                                        |                        |                           |   |   |          |
| Web References:                                                                                                                                                                                     |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| 1                                                                                                                                                                                                   | <a href="https://www.google.com/search?q=web+references+for+Introduction%2C+Queuing+Theory%2C+Operating+characteristics">https://www.google.com/search?q=web+references+for+Introduction%2C+Queuing+Theory%2C+Operating+characteristics</a> |                        |                           |   |   |          |
| 2                                                                                                                                                                                                   | <a href="https://qiml.radiology.wisc.edu/wp-content/uploads/sites/760/2021/03/lecture_A1_07_LineSearch.pdf">https://qiml.radiology.wisc.edu/wp-content/uploads/sites/760/2021/03/lecture_A1_07_LineSearch.pdf</a>                           |                        |                           |   |   |          |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 40                    | 20             | 40                   |            |            |                          |
| Apply                                                       | 60                    | 40             | 30                   |            |            |                          |
| Analyze                                                     |                       | 40             | 30                   |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C510.1      | 3    | 3    | 2    | 1    | 1    | -    | -    | -    | 2    | 1     | 2     | 3     | 3     |
| C510.2      | 3    | 2    | 2    | 2    | 3    | -    | -    | -    | 2    | 2     | 3     | 2     | 1     |
| C510.3      | 2    | 3    | 2    | 2    | 2    | -    | -    | -    | 3    | 3     | 3     | 2     | 3     |
| C510.4      | 2    | 2    | 3    | 3    | 3    | -    | -    | -    | 2    | 2     | 3     | 2     | 2     |
| C510.5      | 2    | 2    | 2    | 2    | 3    | -    | -    | -    | 2    | 2     | 3     | 2     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CourseName                                                                                                                        | Category               | Hours/Week                |   |             | C  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-------------|----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                   |                        | L                         | T | P           |    |
| 24AM511                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | RECOMMENDER SYSTEMS                                                                                                               | PEC                    | 3                         | 0 | 0           | 3  |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Nature of the Course                                                                                                              | Semester               | Data Book/Codes/Standards |   |             |    |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | THEORY                                                                                                                            | -                      | -                         |   |             |    |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                   | Co-requisite Course(s) |                           |   |             |    |
| Machine Learning, Data Structures and Algorithms                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                   |                        |                           |   |             |    |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                   |                        |                           |   |             |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | To understand the foundations of the recommender system.                                                                          |                        |                           |   |             |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | To learn the significance of machine learning and data mining algorithms for Recommender systems                                  |                        |                           |   |             |    |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | To learn about collaborative filtering                                                                                            |                        |                           |   |             |    |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | To make students design and implement a recommender system.                                                                       |                        |                           |   |             |    |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | To learn collaborative filtering.                                                                                                 |                        |                           |   |             |    |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                   |                        |                           |   |             |    |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                   |                        |                           |   |             |    |
| C511.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Understand and learn the basic concepts of recommender systems.                                                                   |                        |                           |   |             | U  |
| C511.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Implement machine-learning and data-mining algorithms in recommender systems datasets                                             |                        |                           |   |             | AP |
| C511.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics. |                        |                           |   |             | AP |
| C511.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Design and implement attack-resistant and knowledge based recommender systems.                                                    |                        |                           |   |             | AP |
| C511.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Apply different metrics to evaluate recommender systems                                                                           |                        |                           |   |             | AP |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                   |                        |                           |   |             |    |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | INTRODUCTION                                                                                                                      |                        |                           |   | C01         | 9  |
| Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses; covariance matrices - Overview of data mining methods for recommender systems - similarity measures - Dimensionality reduction - Singular Value Decomposition (SVD)                                                                                                                |                                                                                                                                   |                        |                           |   |             |    |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | CONTENT-BASED RECOMMENDATION SYSTEMS                                                                                              |                        |                           |   | C02         | 9  |
| High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms - Hybrid approaches: Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies. |                                                                                                                                   |                        |                           |   |             |    |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | COLLABORATIVE FILTERING                                                                                                           |                        |                           |   | C03         | 9  |
| A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection - Model based and pre-processing based approaches, Attacks on collaborative recommender systems                                                                                                                                                                   |                                                                                                                                   |                        |                           |   |             |    |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | ATTACK-RESISTANT AND KNOWLEDGE BASED RECOMMENDER SYSTEMS                                                                          |                        |                           |   | C04         | 9  |
| Introduction - Types of Attacks - Detecting attacks on recommender systems - Individual attack - Group attack - Strategies for robust recommender design - Robust recommendation algorithms. Knowledge based recommendation: Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders.                                                                                                                                                              |                                                                                                                                   |                        |                           |   |             |    |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | EVALUATING RECOMMENDER SYSTEMS                                                                                                    |                        |                           |   | C05         | 9  |
| Evaluating Paradigms - User Studies - Online and Offline evaluation - Goals of evaluation design - Design Issues Evaluation measures                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                   |                        |                           |   |             |    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                   |                        |                           |   | Total Hours | 45 |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                   |                        |                           |   |             |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Francesco Ricci, Lior Rokach, Bracha Shapira, Recommender Systems Handbook, Springer, 3rd Edition, 2022.                          |                        |                           |   |             |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | P. Pavan Kumar et al., Recommender Systems: Algorithms and Applications, CRC Press, 2021.                                         |                        |                           |   |             |    |
| Reference Books:                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                   |                        |                           |   |             |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Recommender Systems: The Textbook by Charu C. Aggarwal for comprehensive theory,                                                  |                        |                           |   |             |    |



|                       |                                                                                                                                                                       |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | and Recommender Systems Handbook(3rd Edition, 2022)                                                                                                                   |
| 2                     | RecommenderSystemsHandbook(Ricci,Rokach,Shapira,3rdEd.2022):Adefinitivecollectionofchapters by experts covering algorithms, evaluation, and specialized applications. |
| <b>WebReferences:</b> |                                                                                                                                                                       |
| 1                     | <a href="https://onlinecourses.nptel.ac.in/noc24_ge35/preview">https://onlinecourses.nptel.ac.in/noc24_ge35/preview</a>                                               |
| 2                     | <a href="https://en.wikipedia.org/wiki/Recommender_system">https://en.wikipedia.org/wiki/Recommender_system</a>                                                       |

| <b>AssessmentbasedonContinuousandEndSemesterExamination</b> |                             |                          |                               |                   |                   |                                    |
|-------------------------------------------------------------|-----------------------------|--------------------------|-------------------------------|-------------------|-------------------|------------------------------------|
| <b>BLOOM'S<br/>TAXONOMY<br/>LEVEL</b>                       | <b>CONTINUOUSASSESSMENT</b> |                          |                               | <b>ASSIGNMENT</b> | <b>ATTENDANCE</b> | <b>ENDSEMESTERE<br/>XAMINATION</b> |
|                                                             | <b>CIA1<br/>(6Marks)</b>    | <b>CIA2<br/>(6Marks)</b> | <b>ModelExam<br/>(8Marks)</b> | <b>(10Marks)</b>  | <b>(10Marks)</b>  | <b>(60Marks)</b>                   |
| Remember                                                    |                             |                          |                               | 10                | 10                | 60                                 |
| Understand                                                  | 40%                         |                          | 20%                           |                   |                   |                                    |
| Apply                                                       | 60%                         | 100%                     | 80%                           |                   |                   |                                    |
| Analyze                                                     |                             |                          |                               |                   |                   |                                    |
| Evaluate                                                    |                             |                          |                               |                   |                   |                                    |
| Create                                                      |                             |                          |                               |                   |                   |                                    |
| <b>Total<br/>(100Marks)</b>                                 | <b>6</b>                    | <b>6</b>                 | <b>8</b>                      | <b>10</b>         | <b>10</b>         | <b>60</b>                          |

- CIA1, CIA2andModelExamwillbeconductedfor50,50and100marks.Itshallbe subsequently converted to 6, 6 and 8 marks respectively.
- TheAssignmentmarkswillbecomputedbasedonAssignmentI, AssignmentIIandAssignmentIIImarksconvertedto10 Marks.
- BTL mark split up may vary based on thenatureofthesubject.

| <b>COs/<br/>Pos</b> | <b>PO<br/>1</b> | <b>PO<br/>2</b> | <b>PO<br/>3</b> | <b>PO<br/>4</b> | <b>PO<br/>5</b> | <b>PO<br/>6</b> | <b>PO<br/>7</b> | <b>PO<br/>8</b> | <b>PO<br/>9</b> | <b>PO<br/>10</b> | <b>PO<br/>11</b> | <b>PSO<br/>1</b> | <b>PSO2</b> |
|---------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|-------------|
| C511.1              | 3               | 3               | 3               | 2               | 1               | -               | -               | -               | -               | -                | -                | 3                | -           |
| C511.2              | 3               | 3               | 2               | 2               | 1               | -               | -               | -               | -               | -                | -                | 3                | -           |
| C511.3              | 3               | 2               | 3               | 2               | 1               | -               | -               | -               | -               | -                | -                | 3                | -           |
| C511.4              | 3               | 2               | 3               | 2               | 1               | -               | -               | -               | -               | -                | -                | 3                | -           |
| C511.5              | 3               | 3               | 2               | 2               | 1               | -               | -               | -               | -               | -                | -                | 3                | -           |

1-low,2-medium,3-high,'-'-nocorrelation

| Course Code                                                                                                                                                                                                                                                                                                                                            | Course Name                                                                                                                         | Category               | Hours/Week                |   |   | C        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----------|
|                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                     |                        | L                         | T | P |          |
| 24AM512                                                                                                                                                                                                                                                                                                                                                | KNOWLEDGE ENGINEERING                                                                                                               | PE                     | 3                         | 0 | 0 | 3        |
| Regulation                                                                                                                                                                                                                                                                                                                                             | Nature of the Course                                                                                                                | Semester               | Data Book/Codes/Standards |   |   |          |
| 24                                                                                                                                                                                                                                                                                                                                                     | THEORY                                                                                                                              | -                      |                           |   |   |          |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                |                                                                                                                                     | Co-requisite Course(s) |                           |   |   |          |
| Data Structures and Algorithms                                                                                                                                                                                                                                                                                                                         |                                                                                                                                     | -                      |                           |   |   |          |
| Course Objectives                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                     |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                      | To understand the basics of Knowledge Engineering.                                                                                  |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                      | To discuss methodologies and modeling for Agent Design and Development.                                                             |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                                      | To design and develop ontologies.                                                                                                   |                        |                           |   |   |          |
| 4                                                                                                                                                                                                                                                                                                                                                      | To apply reasoning with ontologies and rules.                                                                                       |                        |                           |   |   |          |
| 5                                                                                                                                                                                                                                                                                                                                                      | To understand learning and rule learning                                                                                            |                        |                           |   |   |          |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                     |                        |                           |   |   |          |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                |                                                                                                                                     |                        |                           |   |   |          |
| C512.1                                                                                                                                                                                                                                                                                                                                                 | Understand the basics of Knowledge Engineering.                                                                                     |                        |                           |   |   | [U]      |
| C512.2                                                                                                                                                                                                                                                                                                                                                 | Apply methodologies and modelling for Agent Design and Development.                                                                 |                        |                           |   |   | [AP]     |
| C512.3                                                                                                                                                                                                                                                                                                                                                 | Design and develop ontologies                                                                                                       |                        |                           |   |   | [AP]     |
| C512.4                                                                                                                                                                                                                                                                                                                                                 | Apply reasoning with ontologies and rule                                                                                            |                        |                           |   |   | [AP]     |
| C512.5                                                                                                                                                                                                                                                                                                                                                 | Understand learning and rule learning.                                                                                              |                        |                           |   |   | [U]      |
| Course Contents                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                     |                        |                           |   |   |          |
| Unit-1                                                                                                                                                                                                                                                                                                                                                 | REASONING UNDER UNCERTAINTY                                                                                                         |                        |                           |   |   | C01 9Hrs |
| Introduction-Abductive reasoning-Probabilistic reasoning:Enumerative Probabilities-Subjective Bayesian view-Belief Functions-Baconian Probability-Fuzzy Probability-Uncertainty methods-Evidence-based reasoning - Intelligent Agent - Mixed-Initiative Reasoning - Knowledge Engineering                                                              |                                                                                                                                     |                        |                           |   |   |          |
| Unit-2                                                                                                                                                                                                                                                                                                                                                 | METHODOLOGY AND MODELING                                                                                                            |                        |                           |   |   | C02 9Hrs |
| Conventional Design and Development -Development tools and Reusable Ontologies-Agent Design and Development using Learning Technology-Problem Solving through Analysis and Synthesis-Inquiry-driven Analysis and Synthesis-Evidence-based Assessment- Believability Assessment -Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios |                                                                                                                                     |                        |                           |   |   |          |
| Unit-3                                                                                                                                                                                                                                                                                                                                                 | ONTOLOGIES-DESIGN AND DEVELOPMENT                                                                                                   |                        |                           |   |   | C03 9Hrs |
| Concepts and Instances-Generalization Hierarchies-Object Features-Defining Features-Representation-Transitivity - Inheritance-Concepts as Feature Values -Ontology Matching.Design and Development Methodologies-Steps in Ontology Development-Domain Understanding and Concept Elicitation-Modelling-based Ontology Specification.                    |                                                                                                                                     |                        |                           |   |   |          |
| Unit-4                                                                                                                                                                                                                                                                                                                                                 | REASONING WITH ONTOLOGIES AND RULES                                                                                                 |                        |                           |   |   | C04 9Hrs |
| Production System Architecture-Complex Ontology-based Concepts-Reduction and Synthesis rules and the Inference Engine - Evidence-based hypothesis analysis - Rule and Ontology Matching-Partially Learned Knowledge - Reasoning with Partially Learned Knowledge                                                                                       |                                                                                                                                     |                        |                           |   |   |          |
| Unit-5                                                                                                                                                                                                                                                                                                                                                 | LEARNING AND RULE LEARNING                                                                                                          |                        |                           |   |   | C05 9Hrs |
| Machine Learning -Concepts -Generalization and Specialization Rules- Types -Formal definition of Generalization.Modelling, Learning and Problem Solving-Rule learning and Refinement-Overview-Rule Generation and Analysis - Hypothesis Learning                                                                                                       |                                                                                                                                     |                        |                           |   |   |          |
| Total Hours                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                     |                        |                           |   |   | 45       |
| Textbooks:                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                     |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                      | Artificial Intelligence: A Modern Approach, Stuart Russell, Peter Norvig, Pearson, Fourth Edition, 2020.                            |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                      | Knowledge Graphs, Aidan Hogan, et al., Morgan & Claypool Publishers, First Edition, 2022.                                           |                        |                           |   |   |          |
| Reference Books:                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                     |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                      | Semantic Web for the Working Ontologist, Dean Allemang, James Hendler, Association for Computing Machinery, Third Edition, 2020.    |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                      | Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.                                                          |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                                      | John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000. |                        |                           |   |   |          |
| Web References:                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                     |                        |                           |   |   |          |

|   |                                                                                                                                                                                                                   |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <a href="https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_expert_systems.htm">https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_expert_systems.htm</a> |
| 2 | <a href="https://www.w3.org/standards/semanticweb/ontology">https://www.w3.org/standards/semanticweb/ontology</a>                                                                                                 |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      |            |            |                          |
| Understand                                                  | 60                    |                | 40                   |            |            |                          |
| Apply                                                       | 40                    | 100            | 60                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/ POs | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PS01 | PS02 |
|----------|------|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|------|------|
| C512.1   | 3    | 2   | -   | -   | -   | -   | -   | -   | -   | -     | -     | 2    | -    |
| C512.2   | 2    | 3   | 3   | 2   | 3   | -   | -   | -   | -   | -     | -     | 3    | 2    |
| C512.3   | 2    | 3   | 3   | 2   | 3   | -   | -   | -   | -   | -     | -     | 3    | 2    |
| C512.4   | 2    | 3   | 2   | 3   | 2   | -   | -   | -   | -   | -     | -     | 3    | 2    |
| C512.5   | 2    | 2   | -   | 2   | 2   | -   | -   | -   | -   | -     | -     | 2    | 2    |

1-low, 2-medium, 3-high, '-'-no correlation



# **VERTICAL ANALYTICSENGINEERING**

| Course Code                                                                                                                                                                                                                                                                                                                                                | CourseName                                                                                                    | Category              | Hours/Week               |   |     | C    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|-----|------|
|                                                                                                                                                                                                                                                                                                                                                            |                                                                                                               |                       | L                        | T | P   |      |
| 24AD501                                                                                                                                                                                                                                                                                                                                                    | EXPLORATORYDATA ANALYSIS                                                                                      | PE                    | 3                        | 0 | 0   | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                 | NatureoftheCourse                                                                                             | Semester              | DataBook/Codes/Standards |   |     |      |
| 2024                                                                                                                                                                                                                                                                                                                                                       | THEORY                                                                                                        | -                     | -                        |   |     |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                     |                                                                                                               | Co-requisiteCourse(s) |                          |   |     |      |
| DATAEXPLORATION AND VISUALIZATION                                                                                                                                                                                                                                                                                                                          |                                                                                                               | -                     |                          |   |     |      |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                           |                                                                                                               |                       |                          |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                          | To introduce the concepts and importance of Exploratory Data Analysis in the data scienceworkflow             |                       |                          |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                          | To enable students to understand different types of data and statistical measures used foranalyzing datasets  |                       |                          |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                                                          | To analyze relationships among variables using statistical and visualization techniques                       |                       |                          |   |     |      |
| 4                                                                                                                                                                                                                                                                                                                                                          | To apply various graphical methods and visualization techniques for interpreting data patterns.               |                       |                          |   |     |      |
| 5                                                                                                                                                                                                                                                                                                                                                          | To perform exploratory analysis on real-world datasets and derive meaningful insights.                        |                       |                          |   |     |      |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                             |                                                                                                               |                       |                          |   |     |      |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                                                                             |                                                                                                               |                       |                          |   |     |      |
| C501.1                                                                                                                                                                                                                                                                                                                                                     | Understand the concepts, data types and statistical measures used in exploratory dataanalysis.                |                       |                          |   |     | [U]  |
| C501.2                                                                                                                                                                                                                                                                                                                                                     | Apply techniques to analyze relationships between variables using statistical measures andcontingency tables. |                       |                          |   |     | [AP] |
| C501.3                                                                                                                                                                                                                                                                                                                                                     | Apply visualization principles to represent relationships and patterns in datasets.                           |                       |                          |   |     | [AP] |
| C501.4                                                                                                                                                                                                                                                                                                                                                     | Explore datasets using statistical graphs and visualization techniques                                        |                       |                          |   |     | [AP] |
| C501.5                                                                                                                                                                                                                                                                                                                                                     | Predict exploratory analysis on real-world datasets and interpret results for decisionmaking.                 |                       |                          |   |     | [AP] |
| CourseContents                                                                                                                                                                                                                                                                                                                                             |                                                                                                               |                       |                          |   |     |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                     | INTRODUCTIONTOEXPLORATORYDATAANALYSIS                                                                         |                       |                          |   | C01 | 9Hrs |
| Introduction toExploratoryData Analysis(EDA)– Importance of EDA indata science–Typesof data:numericalandcategoricaldata–Discreteandcontinuousvariables–Distributionof variables– Numericalsummariesofdata:measuresofcentraltendencyanddispersion–Scalingandstandardizingdata– Inequalitymeasures–Introduction to smoothing techniques in time series data. |                                                                                                               |                       |                          |   |     |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                     | ANALYSISOFRELATIONSHIPSINDATA                                                                                 |                       |                          |   | C02 | 9Hrs |
| Relationships between two variables – Scatter plots and correlation – Percentage tables and contingency tables–Analysing relationships in categorical data – Handling multipledatasets–Transformationsof variables –Introducinga third variable–Basiccausalinterpretation–Three-variablecontingency tables– Introduction tolongitudinal data analysis.     |                                                                                                               |                       |                          |   |     |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                     | DATAVISUALIZATIONPRINCIPLES                                                                                   |                       |                          |   | C03 | 9Hrs |
| Principlesofdatavisualization–Stagesofvisualizingdata–Mappingdatatovisualelements– Visualizingrelationshipsandcorrelations–Scatterplotmaps– Visualizationof hierarchiesand trees– Networkandgraphvisualization – Data acquisition and parsing for visualization.                                                                                           |                                                                                                               |                       |                          |   |     |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                     | STATISTICALGRAPHSANDVISUALANALYSIS                                                                            |                       |                          |   | C04 | 9Hrs |
| Histograms and density curves–Frequency polygons–Boxplotsandviolinplots–Dotplotsforgroupeddata– Two-dimensional density plots – Correlation matrix visualization –Heatmaps–Three-dimensionalscatterplots– Dendrograms – Q–Qplotsandmosaicplots.                                                                                                            |                                                                                                               |                       |                          |   |     |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                     | APPLICATIONSOFDATAEXPLORATION                                                                                 |                       |                          |   | C05 | 9Hrs |
| Applications ofEDA inreal-world datasets – Datahandlingandpreprocessing – Loadingandtransforming datasets–Creatingtidydata–Basicexploratoryanalysisworkflow–Visualizationfordecisionmaking– Casestudy:Analysis ofstudent academic performance data.                                                                                                        |                                                                                                               |                       |                          |   |     |      |
| TotalHours                                                                                                                                                                                                                                                                                                                                                 |                                                                                                               |                       |                          |   |     | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                 |                                                                                                               |                       |                          |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                          | Suresh Kumar Mukhiya, Usman Ahmed, Hands-On Exploratory Data Analysis with Python, Packt                      |                       |                          |   |     |      |

|                         |                                                                                                            |
|-------------------------|------------------------------------------------------------------------------------------------------------|
|                         | Publishing, 2020.                                                                                          |
| 2                       | W. Martinez, A. Martinez, J. L. Solka, Exploratory Data Analysis with MATLAB, CRC Press, 3rd Edition, 2017 |
| <b>Reference Books:</b> |                                                                                                            |
| 1                       | Michael Jambu, Exploratory and Multivariate Data Analysis, Academic Press                                  |
| 2                       | Charu C. Aggarwal, Data Mining: The Textbook, Springer, 2015                                               |
|                         | Craig K. Enders, Applied Missing Data Analysis, The Guilford Press, 2010.                                  |
| <b>Web References:</b>  |                                                                                                            |
| 1                       | Kaggle – <a href="https://www.kaggle.com/learn">https://www.kaggle.com/learn</a>                           |
| 2                       | Towards Data Science – <a href="https://towardsdatascience.com">https://towardsdatascience.com</a>         |
| 3                       | Scikit-learn Documentation – <a href="https://scikit-learn.org">https://scikit-learn.org</a>               |
| 4                       | Pandas Documentation – <a href="https://pandas.pydata.org">https://pandas.pydata.org</a>                   |
| 5                       | Matplotlib Documentation – <a href="https://matplotlib.org">https://matplotlib.org</a>                     |
| 6                       | Seaborn Documentation – <a href="https://seaborn.pydata.org">https://seaborn.pydata.org</a>                |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 60%                   |                | 20%                  |            |            |                          |
| Apply                                                       | 40%                   | 100%           | 80%                  |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C501.1      | 3    | 2    | -    | -    | 1    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 2     |
| C501.2      | 3    | 3    | 1    | 2    | 2    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 2     |
| C501.3      | 2    | 3    | 2    | 2    | 3    | -    | -    | -    | -    | -     | 2     | 3     | 2     | 2     |
| C501.4      | 2    | 3    | 2    | 3    | 3    | -    | -    | -    | -    | -     | 2     | 3     | 2     | 2     |
| C501.5      | 2    | 3    | 3    | 3    | 3    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                           | Course Name                                                                                                                                       | Category               | Hours/Week                |   |   | C    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|
|                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                   |                        | L                         | T | P |      |
| 24AD502                                                                                                                                                                                                                                                                                                                               | IMAGE AND VIDEO ANALYTICS                                                                                                                         | PE                     | 3                         | 0 | 0 | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                            | Nature of the Course                                                                                                                              | Semester               | Data Book/Codes/Standards |   |   |      |
| 2024                                                                                                                                                                                                                                                                                                                                  | THEORY                                                                                                                                            | -                      | -----                     |   |   |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                               |                                                                                                                                                   | Co-requisite Course(s) |                           |   |   |      |
| -                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                   | -                      |                           |   |   |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                   |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                     | To understand the basics of image processing techniques for computer vision.                                                                      |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                     | To learn the techniques used for image pre-processing.                                                                                            |                        |                           |   |   |      |
| 3                                                                                                                                                                                                                                                                                                                                     | To discuss the various object detection techniques.                                                                                               |                        |                           |   |   |      |
| 4                                                                                                                                                                                                                                                                                                                                     | To understand the various Object recognition mechanisms.                                                                                          |                        |                           |   |   |      |
| 5                                                                                                                                                                                                                                                                                                                                     | To elaborate on the video analytics techniques.                                                                                                   |                        |                           |   |   |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                   |                        |                           |   |   |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                               |                                                                                                                                                   |                        |                           |   |   |      |
| C502.1                                                                                                                                                                                                                                                                                                                                | Understand the basics of image processing techniques for computer vision and video analysis.                                                      |                        |                           |   |   | [U]  |
| C502.2                                                                                                                                                                                                                                                                                                                                | Explain the techniques used for image pre-processing.                                                                                             |                        |                           |   |   | [U]  |
| C502.3                                                                                                                                                                                                                                                                                                                                | Apply Various object detection techniques to solve real world image analysis problems.                                                            |                        |                           |   |   | [AP] |
| C502.4                                                                                                                                                                                                                                                                                                                                | Apply various face recognition mechanisms to develop and implement real world recognition systems.                                                |                        |                           |   |   | [AP] |
| C502.5                                                                                                                                                                                                                                                                                                                                | Apply deep learning techniques to analyze and interpret video data for real world video analytics applications.                                   |                        |                           |   |   | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                   |                        |                           |   |   |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                | INTRODUCTION TO IMAGE ANALYTICS                                                                                                                   |                        |                           |   |   | 9    |
| Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation- Traditional and Hierarchical image data structures.                                                                    |                                                                                                                                                   |                        |                           |   |   |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                | IMAGE PRE-PROCESSING                                                                                                                              |                        |                           |   |   | 9    |
| Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models - Edges in multi-spectral images - Local pre-processing in the frequency domain - Line detection by local pre-processing operators - Image restoration. |                                                                                                                                                   |                        |                           |   |   |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                | OBJECT DETECTION USING MACHINE LEARNING                                                                                                           |                        |                           |   |   | 9    |
| Object detection– Object detection methods – Deep Learning framework for Object detection – bounding box approach - Intersection over Union (IoU) – Deep Learning Architectures - R-CNN - Faster R-CNN - You Only Look Once (YOLO) – Salient features - Loss Functions - YOLO architectures                                           |                                                                                                                                                   |                        |                           |   |   |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                | FACE RECOGNITION AND GESTURE RECOGNITION                                                                                                          |                        |                           |   |   | 9    |
| Face Recognition - Introduction - Applications of Face Recognition - Process of Face Recognition - DeepFace solution by Facebook - FaceNet for Face Recognition - Implementation using FaceNet - Gesture Recognition.                                                                                                                 |                                                                                                                                                   |                        |                           |   |   |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                | VIDEO ANALYTICS                                                                                                                                   |                        |                           |   |   | 9    |
| Video Processing – use cases of video analytics - Vanishing Gradient and exploding gradient problem - ResNet architecture - ResNet and skip connections - Inception Network - GoogleNet architecture - Improvement in Inception v2 - Video analytics - ResNet and Inception v3.                                                       |                                                                                                                                                   |                        |                           |   |   |      |
| Total Hours                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                   |                        |                           |   |   | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                   |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                     | Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 4th edition, Thomson Learning, 2013.                   |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                     | Vaibhav Verdhhan, (2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras, Apress 2021 (UNIT-III, IV and V) |                        |                           |   |   |      |
| Reference Books:                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                   |                        |                           |   |   |      |

|                        |                                                                                                                     |
|------------------------|---------------------------------------------------------------------------------------------------------------------|
| 1                      | Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London Limited, 2011.             |
| 2                      | Caifeng Shan, Fatih Porikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", Springer, 2012. |
| 3                      | D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003.                             |
| 4                      | E. R. Davies, (2012), "Computer & Machine Vision", Fourth Edition, Academic Press.                                  |
| <b>Web References:</b> |                                                                                                                     |
| 1                      | <a href="https://nptel.ac.in/courses/106101061">https://nptel.ac.in/courses/106101061</a>                           |
| 2                      | <a href="https://nptel.ac.in/courses/106105087">https://nptel.ac.in/courses/106105087</a>                           |
| 3                      | <a href="https://nptel.ac.in/courses/106105182">https://nptel.ac.in/courses/106105182</a>                           |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                                                    |                       |                   |                         | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand                                                  | 100%                  | 20%               | 30%                     |            |            |                          |
| Apply                                                       |                       | 80%               | 70%                     |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| Total (100 Marks)                                           | 6                     | 6                 | 8                       | 10         | 10         | 60                       |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C502.1      | 3    | 1    | 2    | 2    | -    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 3     |
| C502.2      | 2    | 2    | 3    | 3    | -    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 2     |
| C502.3      | 1    | 2    | 2    | 2    | -    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 3     |
| C502.4      | 1    | 2    | 3    | 2    | -    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 2     |
| C502.5      | 3    | 2    | 1    | 3    | -    | -    | -    | -    | -    | -     | 2     | 3     | 2     | 2     |

| Course Code                                                                                                                                                                                                                                                                                                                                                                      | Course Name                                                                                                                | Category               | Hours/Week                |   |             | C    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-------------|------|
|                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                            |                        | L                         | T | P           |      |
| 24AD503                                                                                                                                                                                                                                                                                                                                                                          | HEALTHCARE ANALYTICS                                                                                                       | PE                     | 3                         | 0 | 0           | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                       | Nature of the Course                                                                                                       | Semester               | Data Book/Codes/Standards |   |             |      |
| 2024                                                                                                                                                                                                                                                                                                                                                                             | THEORY                                                                                                                     |                        | -                         |   |             |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                            | Co-requisite Course(s) |                           |   |             |      |
| -                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                            | -                      |                           |   |             |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                            |                        |                           |   |             |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                | Understand the health data formats, health care policy and standards                                                       |                        |                           |   |             |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                | Learn the significance and need of data analysis and data visualization                                                    |                        |                           |   |             |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                | Understand the health data management frameworks                                                                           |                        |                           |   |             |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                | Learn the use of machine learning and deep learning algorithms in healthcare                                               |                        |                           |   |             |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                | Apply healthcare analytics for critical care applications                                                                  |                        |                           |   |             |      |
| Course Outcomes --- Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                      |                                                                                                                            |                        |                           |   |             |      |
| C503.1                                                                                                                                                                                                                                                                                                                                                                           | Understand machine learning and deep learning algorithms for health data analysis                                          |                        |                           |   |             | [U]  |
| C503.2                                                                                                                                                                                                                                                                                                                                                                           | Apply the data management techniques for healthcare data                                                                   |                        |                           |   |             | [AP] |
| C503.3                                                                                                                                                                                                                                                                                                                                                                           | Examine the need of healthcare data analysis in e-healthcare, telemedicine and other critical care applications            |                        |                           |   |             | [AP] |
| C503.4                                                                                                                                                                                                                                                                                                                                                                           | Design health data analytics for real time applications                                                                    |                        |                           |   |             | [AP] |
| C503.5                                                                                                                                                                                                                                                                                                                                                                           | Use emergency care system using health data analysis                                                                       |                        |                           |   |             | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                            |                        |                           |   |             |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                           | INTRODUCTION TO HEALTHCARE ANALYSIS                                                                                        |                        |                           |   | C01         | 9    |
| Overview - History of Healthcare Analysis Parameters on medical care systems- Need for Healthcare Analytics - Foundations of Healthcare Analytics - Healthcare privacy and ethics, Healthcare laws and Acts - Standardized codesets - Machine Learning Foundations: Tree Like reasoning , Probabilistic reasoning and Bayes Theorem                                              |                                                                                                                            |                        |                           |   |             |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                           | ANALYTICS ON MACHINE LEARNING                                                                                              |                        |                           |   | C02         | 9    |
| Machine Learning Pipeline - Pre-processing - Visualization - Feature Selection - Training model parameter - Evaluation model: Sensitivity , Specificity , PPV , NPV, FPR , Accuracy , ROC , Precision Recall Curves , Value of target variables - Python Introduction - Pandas Data Frame Operations - Seaborn introduction, Seaborn Vs Matplotlib - Plots for categorical data. |                                                                                                                            |                        |                           |   |             |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                           | HEALTHCARE MANAGEMENT                                                                                                      |                        |                           |   | C03         | 9    |
| IoT - Smart Sensors - Decision Support System - Medicare value-based programs - Matrix block Cipher System - Semantic Framework Analysis - Histogram bin Shifting and Rc6 Encryption - Clinical Prediction Models - Visual Analytics for Healthcare.                                                                                                                             |                                                                                                                            |                        |                           |   |             |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                           | HEALTHCARE AND DEEP LEARNING                                                                                               |                        |                           |   | C04         | 9    |
| Introduction on Deep Learning - DFF network CNN- RNN for Sequences - Biomedical Image and Signal Analysis - Natural Language Processing and Data Mining for Clinical Data - Mobile imaging and Analytics - Clinical Decision Support System.                                                                                                                                     |                                                                                                                            |                        |                           |   |             |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                           | HEALTHCARE ANALYTICS APPLICATIONS & CASE STUDIES                                                                           |                        |                           |   | C05         | 9    |
| Introduction - Descriptive Analytics Applications - Predictive Analytics Applications - Prescriptive Analytics Application Predicting Mortality for cardiology Practice - Smart Ambulance System using IoT - Hospital Acquired Conditions (HAC) program - Healthcare and Emerging Technologies - ECG Data Analysis.                                                              |                                                                                                                            |                        |                           |   |             |      |
|                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                            |                        |                           |   | Total Hours | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                            |                        |                           |   |             |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                | Chandan K.Reddy, Charu C. Aggarwal, "Health Care data Analysis", First edition, CRC, 2015.                                 |                        |                           |   |             |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                | Hui Jang, Eva K.Lee, "Health Care Analysis: From Data to Knowledge to Healthcare Improvement", First Edition, Wiley, 2016. |                        |                           |   |             |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                | Vikas Kumar, "Health Care Analysis Made Simple", Packt Publishing, 2018.                                                   |                        |                           |   |             |      |
| Reference Books:                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                            |                        |                           |   |             |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                | Nilanjan Dey, Amira Ashour , Simon James Fong, Chintan Bhatl, "Health Care Data Analysis and                               |                        |                           |   |             |      |

|                        |                                                                                                                                                             |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | Management, First Edition, Academic Press, 2018.                                                                                                            |
| 2                      | Kulkarni, Siarry, Singh, Abraham, Zhang, Zomaya, Baki, "Big Data Analytics in Health Care", Springer, 2020.                                                 |
| 3                      | Dinov, Ivo D. "Data Science and Predictive Analytics." Springer, Ann Arbor, MI, USA<br><a href="https://doi.org/10.1007">https://doi.org/10.1007</a> (2018) |
| 4                      | El Morr, Christo, and Hossam Ali-Hassan. Analytics in healthcare: a practical introduction. Springer, 2019.                                                 |
| <b>Web References:</b> |                                                                                                                                                             |
| 1                      | <a href="https://scikit-learn.org/stable">https://scikit-learn.org/stable</a>                                                                               |
| 2                      | <a href="https://www.tensorflow.org/">https://www.tensorflow.org/</a>                                                                                       |

**Assessment based on Continuous and End Semester Examination**

| BLOOM'S TAXONOMY LEVEL   | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|--------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
|                          | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                 |                       |                |                      | 10         | 10         | 60                       |
| Understand               | 80%                   | 100%           | 20%                  |            |            |                          |
| Apply                    | 20%                   |                | 80%                  |            |            |                          |
| Analyze                  |                       |                |                      |            |            |                          |
| Evaluate                 |                       |                |                      |            |            |                          |
| Create                   |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PS01 | PS02 | PS03 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| C503-1      | 3   | 3   | 3   | 1   | -   | -   | -   | -   | -   | -    | 1    | 2    | 2    | 2    |
| C503-2      | 3   | 1   | 1   | 3   | -   | -   | -   | -   | -   | -    | 3    | 3    | 3    | 3    |
| C503-3      | 2   | 1   | 2   | 1   | -   | -   | -   | -   | -   | -    | 1    | 3    | 2    | 2    |
| C503-4      | 2   | 2   | 3   | 3   | -   | -   | -   | -   | -   | -    | 1    | 3    | 2    | 2    |
| C503-5      | 1   | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | 3    | 2    | 2    | 2    |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                | Course Name                                                                                                                                                                                                                             | Category               | Hours/Week                |   |     | C    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-----|------|
|                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                         |                        | L                         | T | P   |      |
| 24AD504                                                                                                                                                                                                                                                                                                                                                                    | TEXT AND SPEECH ANALYSIS                                                                                                                                                                                                                | PE                     | 3                         | 0 | 0   | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                 | Nature of the Course                                                                                                                                                                                                                    | Semester               | Data Book/Codes/Standards |   |     |      |
| 2024                                                                                                                                                                                                                                                                                                                                                                       | THEORY                                                                                                                                                                                                                                  |                        | NIL                       |   |     |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                         | Co-requisite Course(s) |                           |   |     |      |
| Machine Learning                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                         | Deep Learning          |                           |   |     |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                          | To understand fundamental NLP concepts and text representation techniques.                                                                                                                                                              |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                          | To apply embeddings and deep learning models for text classification and analysis.                                                                                                                                                      |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                                                                          | To design and evaluate question answering and dialogue systems.                                                                                                                                                                         |                        |                           |   |     |      |
| 4                                                                                                                                                                                                                                                                                                                                                                          | To study techniques for text-to-speech synthesis using signal processing and deep learning methods.                                                                                                                                     |                        |                           |   |     |      |
| 5                                                                                                                                                                                                                                                                                                                                                                          | To develop automatic speech recognition systems and evaluate their performance.                                                                                                                                                         |                        |                           |   |     |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| C504.1                                                                                                                                                                                                                                                                                                                                                                     | Explain existing and emerging deep learning architectures for text and speech Processing                                                                                                                                                |                        |                           |   |     | [U]  |
| C504.2                                                                                                                                                                                                                                                                                                                                                                     | Implement text classification using embeddings and deep learning.                                                                                                                                                                       |                        |                           |   |     | [AP] |
| C504.3                                                                                                                                                                                                                                                                                                                                                                     | Apply question answering and dialogue systems.                                                                                                                                                                                          |                        |                           |   |     | [AP] |
| C504.4                                                                                                                                                                                                                                                                                                                                                                     | Apply text-to-speech synthesis systems.                                                                                                                                                                                                 |                        |                           |   |     | [AP] |
| C504.5                                                                                                                                                                                                                                                                                                                                                                     | Use speech recognition systems.                                                                                                                                                                                                         |                        |                           |   |     | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                     | NATURAL LANGUAGE BASICS                                                                                                                                                                                                                 |                        |                           |   | C01 | 9Hrs |
| Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling– Text tokenization – Stemming – Lemmatization – Removing stop words– Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model – Text Similarity (Similarity Metrics used in Text Analytics).                     |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                     | TEXT CLASSIFICATION                                                                                                                                                                                                                     |                        |                           |   | C02 | 9Hrs |
| Vector Semantics and Embeddings– Word Embeddings– Word2Vec Model– GloVe Model– FastText Model– Overview of Deep Learning Models– Recurrent Neural Networks (RNN) – Long Short-Term Memory (LSTM) – Transformers Architecture – Attention Mechanism – Introduction to BERT – Applications of BERT in Text Classification – Overview of Text Summarization and Topic Models. |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                     | QUESTION ANSWERING AND DIALOGUE SYSTEMS                                                                                                                                                                                                 |                        |                           |   | C03 | 9Hrs |
| Information Retrieval – IR-based Question Answering – Knowledge-based Question Answering – Language Models for QA– Classical QA Models– Transformer-based Question Answering– BERT-based QA Models– Chatbots– Design of Dialogue Systems – Evaluation of Dialogue Systems.                                                                                                 |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                     | TEXT-TO-SPEECH SYNTHESIS                                                                                                                                                                                                                |                        |                           |   | C04 | 9Hrs |
| SYNTHESIS Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing – Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems.                                                                                                                                                                                        |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                     | AUTOMATIC SPEECH RECOGNITION                                                                                                                                                                                                            |                        |                           |   | C05 | 9Hrs |
| Speech recognition: Feature Extraction – Acoustic modeling – HMM (Hidden Markov Models), HMM-DNN systems – Language Models– LSTM– Decoding Strategies– Evaluation of ASR systems– Word Error rate, Recognition accuracy.                                                                                                                                                   |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                         |                        |                           |   |     | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                         |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                          | Daniel Jurafsky and James H. Martin, <i>Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition with Language Models</i> , Third Edition Draft, January 2026. |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                          | Steven Bird, Ewan Klein, and Edward Loper, <i>Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit</i> , O'Reilly Media, Updated Reprint Edition, 2017.                                            |                        |                           |   |     |      |

| Reference Books: |                                                                                                                                                                                                     |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                | Lewis Tunstall, Leandro von Werra, and Thomas Wolf, <i>Natural Language Processing with Transformers: Building Language Applications with Hugging Face</i> , Revised Edition, O'Reilly Media, 2022. |
| 2                | Ian Goodfellow, Yoshua Bengio, and Aaron Courville, <i>Deep Learning</i> , The MIT Press, 2016 (latest widely used edition).                                                                        |
| 3                | Lawrence Rabiner and Biing-Hwang Juang, <i>Fundamentals of Speech Recognition</i> , Prentice Hall, 1993 (classic foundational edition).                                                             |
| 4                | Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze, <i>Introduction to Information Retrieval</i> , Cambridge University Press, Updated Digital Edition, 2022.                          |
| 5                | Paul Taylor, <i>Text-to-Speech Synthesis</i> , Cambridge University Press, 2009 (standard reference for TTS).                                                                                       |
| Web References:  |                                                                                                                                                                                                     |
| 1                | <a href="https://onlinecourses.nptel.ac.in/noc26_cs45/preview?">https://onlinecourses.nptel.ac.in/noc26_cs45/preview?</a>                                                                           |
| 2                | <a href="https://www.coursera.org/specializations/natural-language-processing?">https://www.coursera.org/specializations/natural-language-processing?</a>                                           |

#### Assessment based on Continuous and End Semester Examination

| BLOOM'S TAXONOMY LEVEL   | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|--------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
|                          | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                 |                       |                |                      | 10         | 10         | 60                       |
| Understand               | 80%                   |                | 20%                  |            |            |                          |
| Apply                    | 20%                   | 100%           | 80%                  |            |            |                          |
| Analyze                  |                       |                |                      |            |            |                          |
| Evaluate                 |                       |                |                      |            |            |                          |
| Create                   |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C504.1      | 3    | 2    | -    | -    | -    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 2     |
| C504.2      | 3    | 3    | 2    | 2    | -    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 2     |
| C504.3      | 3    | 3    | 3    | 2    | -    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 2     |
| C504.4      | 3    | 2    | 2    | 2    | -    | -    | -    | -    | -    | -     | 2     | 2     | 3     | 2     |
| C504.5      | 3    | 3    | 2    | 3    | -    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                           | Course Name                                                                                    | Category               | Hours/Week                |   |   | C        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----------|
|                                                                                                                                                                                                                                                                                                                                                       |                                                                                                |                        | L                         | T | P |          |
| 24AD505                                                                                                                                                                                                                                                                                                                                               | BUSINESS ANALYTICS                                                                             | PE                     | 3                         | 0 | 0 | 3        |
| Regulation                                                                                                                                                                                                                                                                                                                                            | Nature of the Course                                                                           | Semester               | Data Book/Codes/Standards |   |   |          |
| 2024                                                                                                                                                                                                                                                                                                                                                  | THEORY                                                                                         | -                      | -                         |   |   |          |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                               |                                                                                                | Co-requisite Course(s) |                           |   |   |          |
| Fundamentals of Data Science and Analytics                                                                                                                                                                                                                                                                                                            |                                                                                                | -                      |                           |   |   |          |
| Course Objectives                                                                                                                                                                                                                                                                                                                                     |                                                                                                |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                     | To understand the Analytics Life Cycle.                                                        |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                     | To comprehend the process of acquiring Business Intelligence                                   |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                                     | To understand various types of analytics for Business Forecasting                              |                        |                           |   |   |          |
| 4                                                                                                                                                                                                                                                                                                                                                     | To model the supply chain management for Analytics.                                            |                        |                           |   |   |          |
| 5                                                                                                                                                                                                                                                                                                                                                     | To apply analytics for different functions of a business                                       |                        |                           |   |   |          |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                       |                                                                                                |                        |                           |   |   |          |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                               |                                                                                                |                        |                           |   |   |          |
| C505.1                                                                                                                                                                                                                                                                                                                                                | Explain the real-world business problems and model with analytical solutions.                  |                        |                           |   |   | [U]      |
| C505.2                                                                                                                                                                                                                                                                                                                                                | Outline the business processes for extracting Business Intelligence                            |                        |                           |   |   | [U]      |
| C505.3                                                                                                                                                                                                                                                                                                                                                | Apply predictive analytics for business forecasting                                            |                        |                           |   |   | [AP]     |
| C505.4                                                                                                                                                                                                                                                                                                                                                | Apply analytics for supply chain and logistics management                                      |                        |                           |   |   | [AP]     |
| C505.5                                                                                                                                                                                                                                                                                                                                                | Use analytics for marketing and sales.                                                         |                        |                           |   |   | [AP]     |
| Course Contents                                                                                                                                                                                                                                                                                                                                       |                                                                                                |                        |                           |   |   |          |
| Unit-1                                                                                                                                                                                                                                                                                                                                                | INTRODUCTION TO BUSINESS ANALYTICS                                                             |                        |                           |   |   | C01 9Hrs |
| Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration – Introduction to Real-World Business Case Studies in Analytics.                                 |                                                                                                |                        |                           |   |   |          |
| Unit-2                                                                                                                                                                                                                                                                                                                                                | BUSINESS INTELLIGENCE                                                                          |                        |                           |   |   | C02 9Hrs |
| Data Warehouses and Data Mart – Knowledge Management – Types of Decisions – Decision Making Process – Decision Support Systems – Business Intelligence – OLAP – Analytic functions – Introduction to Data Visualization Tools: Power BI and Tableau – Dashboard Creation and Business Reporting.                                                      |                                                                                                |                        |                           |   |   |          |
| Unit-3                                                                                                                                                                                                                                                                                                                                                | BUSINESS FORECASTING                                                                           |                        |                           |   |   | C03 9Hrs |
| Introduction to Business Forecasting and Predictive Analytics – Logic and Data-driven Models – Data Mining and Predictive Analysis Modeling – Machine Learning for Predictive Analytics – Time Series Forecasting Models – Trend Analysis – Moving Average and Exponential Smoothing Methods.                                                         |                                                                                                |                        |                           |   |   |          |
| Unit-4                                                                                                                                                                                                                                                                                                                                                | HR & SUPPLY CHAIN ANALYTICS                                                                    |                        |                           |   |   | C04 9Hrs |
| Human Resources – Planning and Recruitment – Training and Development – Supply chain network – Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain – Applying HR Analytics to make a prediction of the demand for hourly employees for a year – Real-world Case Studies in HR and Supply Chain Analytics. |                                                                                                |                        |                           |   |   |          |
| Unit-5                                                                                                                                                                                                                                                                                                                                                | MARKETING & SALES ANALYTICS                                                                    |                        |                           |   |   | C05 9Hrs |
| Marketing Strategy – Marketing Mix – Customer Behaviour – Selling Process – Sales Planning – Analytics Applications in Marketing and Sales – Predictive Analytics for Customer Behaviour – Customer Segmentation – Marketing and Sales Case Studies using Business Analytics Tools.                                                                   |                                                                                                |                        |                           |   |   |          |
| Total Hours                                                                                                                                                                                                                                                                                                                                           |                                                                                                |                        |                           |   |   | 45       |
| Textbooks:                                                                                                                                                                                                                                                                                                                                            |                                                                                                |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                     | James R. Evans, Business Analytics, 3rd Edition, Pearson Education, 2020.                      |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                     | R. N. Prasad and Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016.  |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                                     | Deanne Larson, Modern Business Analytics, O'Reilly, 2024.                                      |                        |                           |   |   |          |
| Reference Books:                                                                                                                                                                                                                                                                                                                                      |                                                                                                |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                     | Philip Kotler, Kevin Lane Keller, Marketing Management, 17th Edition, Pearson Education, 2025. |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                     | VSPRAO, Human Resource Management, 3rd Edition, Excel Books, 2010.                             |                        |                           |   |   |          |

|                       |                                                                                                                           |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------|
| 3                     | Amar Sahay, Business Analytics, Business Expert Press, 2019.                                                              |
| <b>WebReferences:</b> |                                                                                                                           |
| 1                     | <a href="https://onlinecourses.nptel.ac.in/noc26_cs64/preview?">https://onlinecourses.nptel.ac.in/noc26_cs64/preview?</a> |
| 2                     | <a href="https://www.ibm.com/topics/business-analytics">https://www.ibm.com/topics/business-analytics</a>                 |

**Assessment based on Continuous and End Semester Examination**

| BLOOM'S TAXONOMY LEVEL   | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|--------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
|                          | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                 |                       |                |                      | 10         | 10         | 60                       |
| Understand               | 100%                  | 50%            | 40%                  |            |            |                          |
| Apply                    |                       | 50%            | 60%                  |            |            |                          |
| Analyze                  |                       |                |                      |            |            |                          |
| Evaluate                 |                       |                |                      |            |            |                          |
| Create                   |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C505.1      | 3    | 3    | 2    | 2    | -    | -    | -    | -    | -    | 2     | 2     | 2     | 3     | 2     |
| C505.2      | 2    | 3    | 1    | 2    | -    | -    | -    | -    | -    | 2     | 2     | 3     | 3     | 2     |
| C505.3      | 2    | 3    | 2    | 2    | -    | -    | -    | -    | -    | 2     | 2     | 3     | 3     | 2     |
| C505.4      | 2    | 3    | 2    | 2    | -    | 2    | -    | -    | -    | 2     | 2     | 3     | 3     | 2     |
| C505.5      | 2    | 3    | 2    | 2    | -    | 1    | -    | -    | -    | 2     | 2     | 3     | 3     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                               | Course Name                                                                                                                                                                                                                                                            | Category               | Hours/Week                |   |   | C    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|
|                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                        |                        | L                         | T | P |      |
| 24AD506                                                                                                                                                                                                                                   | Ethics and Artificial Intelligence                                                                                                                                                                                                                                     | PE                     | 3                         | 0 | 0 | 3    |
| Regulation                                                                                                                                                                                                                                | Nature of the Course                                                                                                                                                                                                                                                   | Semester               | Data Book/Codes/Standards |   |   |      |
| 2024                                                                                                                                                                                                                                      | THEORY                                                                                                                                                                                                                                                                 |                        | -----                     |   |   |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                        | Co-requisite Course(s) |                           |   |   |      |
| Artificial Intelligence –1                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                        | -                      |                           |   |   |      |
| Course Objectives                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                        |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                         | Study the morality and ethics in AI                                                                                                                                                                                                                                    |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                         | Learn about the Ethical initiatives in the field of artificial intelligence                                                                                                                                                                                            |                        |                           |   |   |      |
| 3                                                                                                                                                                                                                                         | Study about AI standards and Regulations                                                                                                                                                                                                                               |                        |                           |   |   |      |
| 4                                                                                                                                                                                                                                         | Study about social and ethical issues of Robot Ethics                                                                                                                                                                                                                  |                        |                           |   |   |      |
| 5                                                                                                                                                                                                                                         | Study about AI and Ethics- challenges and opportunities                                                                                                                                                                                                                |                        |                           |   |   |      |
| Course Outcomes                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                        |                        |                           |   |   |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                   |                                                                                                                                                                                                                                                                        |                        |                           |   |   |      |
| C506.1                                                                                                                                                                                                                                    | Understand the concepts of morality, ethics, and ethical harms in Artificial Intelligence.                                                                                                                                                                             |                        |                           |   |   | [U]  |
| C506.2                                                                                                                                                                                                                                    | Apply knowledge of real-time AI applications to identify and address associated ethical issues and implementation challenges in practical scenarios.                                                                                                                   |                        |                           |   |   | [AP] |
| C506.3                                                                                                                                                                                                                                    | Examine AI standards and regulations                                                                                                                                                                                                                                   |                        |                           |   |   | [AP] |
| C506.4                                                                                                                                                                                                                                    | Illustrate roboethics including AI agents and the safe design of autonomous and semi-autonomous systems.                                                                                                                                                               |                        |                           |   |   | [AP] |
| C506.5                                                                                                                                                                                                                                    | Use the principles of roboethics, morality, and professional responsibilities in AI development and deployment.                                                                                                                                                        |                        |                           |   |   | [AP] |
| Course Contents                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                        |                        |                           |   |   |      |
| Unit-1                                                                                                                                                                                                                                    | INTRODUCTION TO ETHICAL INITIATIVES IN AI                                                                                                                                                                                                                              |                        |                           |   |   | 9    |
| Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust                                                                  |                                                                                                                                                                                                                                                                        |                        |                           |   |   |      |
| Unit-2                                                                                                                                                                                                                                    | ETHICAL HARMS AND APPLICATIONS                                                                                                                                                                                                                                         |                        |                           |   |   | 9    |
| International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles, Warfare and weaponization.                                                                                               |                                                                                                                                                                                                                                                                        |                        |                           |   |   |      |
| Unit-3                                                                                                                                                                                                                                    | AI STANDARDS AND REGULATION                                                                                                                                                                                                                                            |                        |                           |   |   | 9    |
| Model Process for Addressing Ethical Concerns During System Design- Transparency of Autonomous Systems- Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems |                                                                                                                                                                                                                                                                        |                        |                           |   |   |      |
| Unit-4                                                                                                                                                                                                                                    | ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS                                                                                                                                                                                                                 |                        |                           |   |   | 9    |
| Robot-Roboethics- Ethics and Morality- Moral Theories- Ethics in Science and Technology- Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Roboethics Taxonomy.                      |                                                                                                                                                                                                                                                                        |                        |                           |   |   |      |
| Unit-5                                                                                                                                                                                                                                    | AI AND ETHICS- CHALLENGES AND OPPORTUNITIES                                                                                                                                                                                                                            |                        |                           |   |   | 9    |
| Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI. |                                                                                                                                                                                                                                                                        |                        |                           |   |   |      |
| Total Hours                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                        |                        |                           |   |   | 45   |
| Textbooks:                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                        |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                         | y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield, "The ethics of artificial intelligence: Issues and initiatives", EPRS  European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452-March 2020 |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                         | Patrick Lin, Keith Abney, George A Bekey, " Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014.                                                                                                                               |                        |                           |   |   |      |
| Reference Books:                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                        |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                         | Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017                                                                                                                 |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                         | Mark Coeckelbergh, " AI Ethics", The MIT Press Essential Knowledge series, April 2020                                                                                                                                                                                  |                        |                           |   |   |      |

| <b>WebReferences:</b> |                                                                                                                                                                                                                                                         |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                     | <a href="https://sci-hub.mkssa.top/10.1007/978-3-540-30301-5_65">https://sci-hub.mkssa.top/10.1007/978-3-540-30301-5_65</a>                                                                                                                             |
| 2                     | <a href="https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteen-challenges-and-opportunities/">https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteen-challenges-and-opportunities/</a> |
| 3                     | <a href="https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/">https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/</a>                                                         |
| 4                     | <a href="https://sci-hub.mkssa.top/10.1159/000492428">https://sci-hub.mkssa.top/10.1159/000492428</a>                                                                                                                                                   |

| <b>Assessment based on Continuous and End Semester Examination</b> |                              |                           |                                 |                   |                   |                                 |
|--------------------------------------------------------------------|------------------------------|---------------------------|---------------------------------|-------------------|-------------------|---------------------------------|
| <b>Bloom's Level</b>                                               | <b>Continuous Assessment</b> |                           |                                 | <b>Assignment</b> | <b>Attendance</b> | <b>End Semester Examination</b> |
|                                                                    | <b>CIA1<br/>(6 Marks)</b>    | <b>CIA2<br/>(6 Marks)</b> | <b>Model Exam<br/>(8 Marks)</b> |                   |                   |                                 |
| Remember                                                           |                              |                           |                                 | (10 Marks)        | (10 Marks)        | (60 Marks)                      |
| Understand                                                         | 80%                          |                           | 20%                             |                   |                   |                                 |
| Apply                                                              | 20%                          | 100%                      | 80%                             |                   |                   |                                 |
| Analyze                                                            |                              |                           |                                 |                   |                   |                                 |
| Evaluate                                                           |                              |                           |                                 |                   |                   |                                 |
| Create                                                             |                              |                           |                                 |                   |                   |                                 |
| <b>Total(100 Marks)</b>                                            | <b>6</b>                     | <b>6</b>                  | <b>8</b>                        | <b>10</b>         | <b>10</b>         | <b>60</b>                       |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| <b>COs/<br/>POs</b> | <b>PO 1</b> | <b>PO 2</b> | <b>PO 3</b> | <b>PO 4</b> | <b>PO 5</b> | <b>PO 6</b> | <b>PO 7</b> | <b>PO 8</b> | <b>PO 9</b> | <b>PO 10</b> | <b>PO 11</b> | <b>PSO 1</b> | <b>PSO 2</b> | <b>PSO 3</b> |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|
| C506.1              | 3           | 2           | 3           | 3           | -           | -           | -           | -           | -           | -            | 1            | 3            | 2            | 2            |
| C506.2              | 2           | 1           | 1           | 2           | -           | -           | -           | -           | -           | -            | 1            | 3            | 3            | 2            |
| C506.3              | 2           | 3           | 1           | 1           | -           | -           | -           | -           | -           | -            | 1            | 3            | 2            | 2            |
| C506.4              | 3           | 1           | 3           | 3           | -           | -           | -           | -           | -           | -            | 3            | 2            | 2            | 3            |
| C506.5              | 3           | 1           | 1           | 3           | -           | -           | -           | -           | -           | -            | 3            | 2            | 3            | 3            |

# **VERTICALII FULLSTACKDEVELOPMENT**

| Course Code                                                                                                                                                                                                                                                                                                  | CourseName                                                                                                                   | Category              | Hours/Week               |   |   | C    |      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|---|------|------|
|                                                                                                                                                                                                                                                                                                              |                                                                                                                              |                       | L                        | T | P |      |      |
| 24CC501                                                                                                                                                                                                                                                                                                      | WEBTECHNOLOGY                                                                                                                | PE                    | 3                        | 0 | 0 | 3    |      |
| Regulation                                                                                                                                                                                                                                                                                                   | NatureoftheCourse                                                                                                            | Semester              | DataBook/Codes/Standards |   |   |      |      |
| 2024                                                                                                                                                                                                                                                                                                         | THEORY                                                                                                                       | -                     | -                        |   |   |      |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                       |                                                                                                                              | Co-requisiteCourse(s) |                          |   |   |      |      |
| -                                                                                                                                                                                                                                                                                                            |                                                                                                                              | -                     |                          |   |   |      |      |
| CourseObjectives                                                                                                                                                                                                                                                                                             |                                                                                                                              |                       |                          |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                            | To understand the fundamentals ofwebtechnologies and develop basic web pages using HTMLand CSS.                              |                       |                          |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                            | To learn client-side scripting using JavaScript for creating dynamic web pages with validationand event handling mechanisms. |                       |                          |   |   |      |      |
| 3                                                                                                                                                                                                                                                                                                            | To understand server-side web programming concepts and developweb applications usingServlets and JSP.                        |                       |                          |   |   |      |      |
| 4                                                                                                                                                                                                                                                                                                            | To learn PHP programming andXML technologies for creating dynamic web pages andrepresenting structured data.                 |                       |                          |   |   |      |      |
| 5                                                                                                                                                                                                                                                                                                            | To develop interactive web applications using modern web application frameworks andtechnologies.                             |                       |                          |   |   |      |      |
| CourseOutcomes                                                                                                                                                                                                                                                                                               |                                                                                                                              |                       |                          |   |   |      |      |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                               |                                                                                                                              |                       |                          |   |   |      |      |
| CC501.1                                                                                                                                                                                                                                                                                                      | Understand basic web pages using HTML and CSS fundamental web design concepts.                                               |                       |                          |   |   | [U]  |      |
| CC501.2                                                                                                                                                                                                                                                                                                      | Build dynamic web pages using JavaScript withvalidationtechniques and differentevent handling mechanisms.                    |                       |                          |   |   | [AP] |      |
| CC501.3                                                                                                                                                                                                                                                                                                      | Develop server-sideweb applications using Servlets and JSP.                                                                  |                       |                          |   |   | [AP] |      |
| CC501.4                                                                                                                                                                                                                                                                                                      | Construct simple web pages using PHP and represent data using XML technologies.                                              |                       |                          |   |   | [AP] |      |
| CC501.5                                                                                                                                                                                                                                                                                                      | Develop interactiveweb applications using modern web application frameworks and tools.                                       |                       |                          |   |   | [AP] |      |
| CourseContents                                                                                                                                                                                                                                                                                               |                                                                                                                              |                       |                          |   |   |      |      |
| Unit-1                                                                                                                                                                                                                                                                                                       | WEBESSENTIALS                                                                                                                |                       |                          |   |   | C01  | 9Hrs |
| Evolutionofweb -Webarchitecture - HTML5: Texttags, Graphics, Formelements, Semantictags - CSS3: Selectors,Backgrounds and borders, Text effects, Cascadingandinheritanceof style properties,BoxModel,Positioning-Introductionto responsive design-Bootstrap: Containers, Grids, Typography, Flex, and Forms. |                                                                                                                              |                       |                          |   |   |      |      |
| Unit-2                                                                                                                                                                                                                                                                                                       | CLIENTSIDEPROGRAMMING                                                                                                        |                       |                          |   |   | C02  | 9Hrs |
| JavaScript: AnintroductiontoJavaScript-JavaScriptDOMModel-ExceptionHandling-Validation-Built-inobjects-EventHandling- DHTMLwithJavaScript- JSONintroduction - Syntax - Function -Files.                                                                                                                      |                                                                                                                              |                       |                          |   |   |      |      |
| Unit-3                                                                                                                                                                                                                                                                                                       | SERVERSIDEPROGRAMMING                                                                                                        |                       |                          |   |   | C03  | 9Hrs |
| Webservers - IIS(XAMPP,LAMPP) andTomcatServers ,Servlets:JavaServletArchitecture-ServletLifeCycle-Form GET and POST actions- Session Handling- Understanding Cookies- Data Base Connectivity: JDBC.                                                                                                          |                                                                                                                              |                       |                          |   |   |      |      |
| Unit-4                                                                                                                                                                                                                                                                                                       | PHPandXML                                                                                                                    |                       |                          |   |   | C04  | 9Hrs |
| Anintroductionto PHP: PHP- Using PHP-Variables- Program control- Built-in functions- Form -Validation. XML: Basic XML- Document Type Definition- XML Schema, XML Parsers and Validation,XSL                                                                                                                  |                                                                                                                              |                       |                          |   |   |      |      |
| Unit-5                                                                                                                                                                                                                                                                                                       | WEBAPPLICATIONANDANGULARJS                                                                                                   |                       |                          |   |   | C05  | 9Hrs |
| Web applications- Webapplicationframeworks:MVCframework-AngularJS:Introduction, Data binding,Directives,Modules,Scopes,Controllers,Expressions,Filters,Events,Form-SinglePageApplication-MultipleViews and Routing - Service.                                                                                |                                                                                                                              |                       |                          |   |   |      |      |
| TotalHours                                                                                                                                                                                                                                                                                                   |                                                                                                                              |                       |                          |   |   | 45   |      |
| Textbooks:                                                                                                                                                                                                                                                                                                   |                                                                                                                              |                       |                          |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                            | BradDayley, BrendanDayley, CalebDayley, "Node.js, MongoDBandAngularJSWeb                                                     |                       |                          |   |   |      |      |

|                         |                                                                                                                                                                                                                          |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | Development", 2017, 2nd Edition, Addison Wesley- O'Reilly, USA.                                                                                                                                                          |
| 2                       | Jessica Minnick, Responsive, "Web Design with HTML 5 & CSS, Cengage Learning", 2020, 9th Edition.                                                                                                                        |
| 3                       | Deitel and Deitel and Nieto, Internet and World Wide Web - How to Program, Prentice Hall, 5th Edition, 2011.                                                                                                             |
| <b>Reference Books:</b> |                                                                                                                                                                                                                          |
| 1                       | Angular 6 for Enterprise-Ready Web Applications, Doguhan Uluca, 1st edition, Packt Publishing                                                                                                                            |
| 2                       | Stephen Wynkoop and John Burke "Running a Perfect Website", QUE, 2nd Edition, 1999.                                                                                                                                      |
| 3                       | Chris Bates, Web Programming - Building Intranet Applications, 3rd Edition, Wiley Publications, 2009.                                                                                                                    |
| 4                       | Gopalan N.P. and Akilandeswari J., "Web Technology", Prentice Hall of India, 2011.                                                                                                                                       |
| <b>Web References:</b>  |                                                                                                                                                                                                                          |
| 1                       | <a href="https://nptel.ac.in/courses/106105084-web-architecture,HTTP,web-protocols,and-internet-fundamentals">https://nptel.ac.in/courses/106105084-web-architecture, HTTP, web protocols, and internet fundamentals</a> |
| 2                       | <a href="https://developer.mozilla.org-documentation-for-HTML,CSS,JavaScript,and-web-APIs">https://developer.mozilla.org- documentation for HTML, CSS, JavaScript, and web APIs</a>                                      |

| Assessment based on Continuous and End Semester Examination |                       |               |                     |            |            |                          |
|-------------------------------------------------------------|-----------------------|---------------|---------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |               |                     | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6Marks)         | CIA2 (6Marks) | Model Exam (8Marks) | (10Marks)  | (10Marks)  | (60Marks)                |
| Remember                                                    |                       |               |                     | 10         | 10         | 60                       |
| Understand                                                  | 80                    |               | 20                  |            |            |                          |
| Apply                                                       | 20                    | 100           | 80                  |            |            |                          |
| Analyze                                                     |                       |               |                     |            |            |                          |
| Evaluate                                                    |                       |               |                     |            |            |                          |
| Create                                                      |                       |               |                     |            |            |                          |
| <b>Total (100Marks)</b>                                     | <b>6</b>              | <b>6</b>      | <b>8</b>            | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| CC501.1     | 3    | 2    | 1    | 1    | 2    | -    | -    | -    | -    | -     | 1     | 1     | 2     | 2     |
| CC501.2     | 3    | 2    | 1    | 1    | 3    | -    | -    | -    | -    | -     | 1     | 1     | 2     | 3     |
| CC501.3     | 3    | 2    | 2    | 1    | 3    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 3     |
| CC501.4     | 2    | 2    | 1    | 1    | 2    | -    | -    | -    | -    | -     | 1     | 1     | 2     | 2     |
| CC501.5     | 2    | 2    | 3    | 1    | 3    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 3     |

1-low, 2-medium, 3-high, '-' - no correlation

| Course Code                                                                                                                                                                                                                                                                                      | CourseName                                                                                                                                                                     | Category               | Hours/Week               |   |            | C    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------|---|------------|------|
|                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                |                        | L                        | T | P          |      |
| 24CC502                                                                                                                                                                                                                                                                                          | APPDEVELOPMENT                                                                                                                                                                 | PE                     | 3                        | 0 | 0          | 3    |
| Regulation                                                                                                                                                                                                                                                                                       | NatureoftheCourse                                                                                                                                                              | Semester               | DataBook/Codes/Standards |   |            |      |
| 2024                                                                                                                                                                                                                                                                                             | THEORY                                                                                                                                                                         | -                      | -                        |   |            |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                           |                                                                                                                                                                                | Co- requisiteCourse(s) |                          |   |            |      |
| -                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                | --                     |                          |   |            |      |
| CourseObjectives                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                |                        |                          |   |            |      |
| 1                                                                                                                                                                                                                                                                                                | Tounderstand Fundamentals ofMobile andWebApplications                                                                                                                          |                        |                          |   |            |      |
| 2                                                                                                                                                                                                                                                                                                | To develop NativeApplications                                                                                                                                                  |                        |                          |   |            |      |
| 3                                                                                                                                                                                                                                                                                                | To build HybridApplications                                                                                                                                                    |                        |                          |   |            |      |
| 4                                                                                                                                                                                                                                                                                                | To implement Cross-PlatformApplications                                                                                                                                        |                        |                          |   |            |      |
| 5                                                                                                                                                                                                                                                                                                | To evaluate Non-Functional Characteristics ofApp Frameworks                                                                                                                    |                        |                          |   |            |      |
| CourseOutcomes                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                |                        |                          |   |            |      |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                   |                                                                                                                                                                                |                        |                          |   |            |      |
| CC502.1                                                                                                                                                                                                                                                                                          | Explain the fundamentals of mobile and web application development including native,hybrid, cross-platform, progressive web applications and responsive web design.            |                        |                          |   |            | [U]  |
| CC502.2                                                                                                                                                                                                                                                                                          | Develop basic native mobile applications using Java/Kotlinfor Android and Swift/Objective-CforiOS.                                                                             |                        |                          |   |            | [AP] |
| CC502.3                                                                                                                                                                                                                                                                                          | Build hybrid mobile applications using frameworks such as Ionic andApache Cordova.                                                                                             |                        |                          |   |            | [AP] |
| CC502.4                                                                                                                                                                                                                                                                                          | Implement cross-platform applications using frameworks like React Native, Flutter, and XamarinwithconceptsofJSX, state, andprops.                                              |                        |                          |   |            | [AP] |
| CC502.5                                                                                                                                                                                                                                                                                          | Applythenon-functionalcharacteristicssuchasbuildperformance,debuggingcapability,maintainability,UI/UX,andreusabilitytocompareandselectappropriatemobile application frameworks |                        |                          |   |            | [AP] |
| CourseContents                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                |                        |                          |   |            |      |
| Unit-1                                                                                                                                                                                                                                                                                           | FUNDAMENTALSOFMOBILE&WEBAPPLICATIONDEVELOPMENT                                                                                                                                 |                        |                          |   | C01        | 9Hrs |
| Basics ofWeb and Mobile application development, Android architecture and Flutter framework overview,Native App, HybridApp, Cross-platformApp, WhatisProgressiveWebApp, ResponsiveWebdesign.                                                                                                     |                                                                                                                                                                                |                        |                          |   |            |      |
| Unit-2                                                                                                                                                                                                                                                                                           | NATIVEAPPDEVELOPMENTUSINGJAVA                                                                                                                                                  |                        |                          |   | C02        | 9Hrs |
| NativeWebApp, BenefitsofNativeApp, ScenariostocreateNativeApp, ToolsforcreatingNative ,App, ConsofNativeApp,PopularNativeAppDevelopmentFrameworks, Java&KotlinforAndroid,Swift&Objective-Cfor iOS, Basics ofReact Native, Native Components, JSX, State, Props.                                  |                                                                                                                                                                                |                        |                          |   |            |      |
| Unit-3                                                                                                                                                                                                                                                                                           | HYBRIDAPPDEVELOPMENT                                                                                                                                                           |                        |                          |   | C03        | 9Hrs |
| HybridWebApp, BenefitsofHybridApp, CriteriaforcreatingNativeApp, Toolsforcreating,HybridApp, Consof HybridApp, Popular HybridApp Development Frameworks, Ionic,Apache Cordova.                                                                                                                   |                                                                                                                                                                                |                        |                          |   |            |      |
| Unit-4                                                                                                                                                                                                                                                                                           | CROSS-PLATFORMAPPDEVELOPMENTUSINGREACT-NATIVE                                                                                                                                  |                        |                          |   | C04        | 9Hrs |
| WhatisCross-platformApp, BenefitsofCross-platformApp, CriteriaforcreatingCross-platformApp, ToolsforcreatingCross-platformApp, ConsofCross-platformApp, PopularCrossplatformAppDevelopment Frameworks, Flutter, Xamarin, React-Native, BasicsofReactNative, NativeComponents, JSX, State, Props. |                                                                                                                                                                                |                        |                          |   |            |      |
| Unit-5                                                                                                                                                                                                                                                                                           | NON-FUNCTIONALCHARACTERISTICSOFAPPFRAMEWORKS                                                                                                                                   |                        |                          |   | C05        | 9Hrs |
| Comparison ofdifferentApp frameworks, Build Performance,App Performance, Debugging capabilities, Timeto Market, Maintainability, EaseofDevelopment, UI/UX, Reusability .                                                                                                                         |                                                                                                                                                                                |                        |                          |   |            |      |
|                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                |                        |                          |   | TotalHours | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                |                        |                          |   |            |      |
| 1                                                                                                                                                                                                                                                                                                | HeadFirstAndroidDevelopment, DawnGriffiths, O'Reilly, 1stedition                                                                                                               |                        |                          |   |            |      |
| 2                                                                                                                                                                                                                                                                                                | ApacheCordovainAction, RaymondK. Camden, Manning. 2015                                                                                                                         |                        |                          |   |            |      |
| 3                                                                                                                                                                                                                                                                                                | BeginningFlutter: AHandsOnGuidetoAppDevelopment, MarcoL. Napoli , ISBN: 978-1-119-55082-2, October 2019                                                                        |                        |                          |   |            |      |
| ReferenceBooks:                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                |                        |                          |   |            |      |
| 1                                                                                                                                                                                                                                                                                                | AndroidProgrammingforBeginners, JohnHorton, PacktPublishing, 2ndEdition                                                                                                        |                        |                          |   |            |      |
| 2                                                                                                                                                                                                                                                                                                | Building Cross-Platform Mobile and WebApps for Engineers and Scientists: AnActiveLearning Approach, Pawan Lingras, Matt Triff, Rucha Lingras                                   |                        |                          |   |            |      |
| 3                                                                                                                                                                                                                                                                                                | Beginning AppDevelopment with Flutter>Create Cross-PlatformMobile Apps1sted.Edition, by                                                                                        |                        |                          |   |            |      |

|                       |                                                                                                                                                                                 |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | RapPayne, 2019, Publisher(s): Apress, ISBN: 978-1484251805                                                                                                                      |
| 4                     | ProgrammingAndroidwithKotlin,byPierre-OlivierLaurence,AmandaHinchman-Dominguez, MikeDunn, G. BlakeMeike, December 2021, Publisher(s): O'Reilly Media, Inc., ISBN: 9781492063001 |
| <b>WebReferences:</b> |                                                                                                                                                                                 |
| 1                     | Android Developer Documentation: <a href="https://developer.android.com/docs">https://developer.android.com/docs</a>                                                            |
| 2                     | Flutter Documentation: <a href="https://flutter.dev/docs">https://flutter.dev/docs</a>                                                                                          |

| <b>AssessmentbasedonContinuousandEndSemesterExamination</b> |                             |                          |                               |                        |                   |                                         |
|-------------------------------------------------------------|-----------------------------|--------------------------|-------------------------------|------------------------|-------------------|-----------------------------------------|
| <b>BLOOM'S<br/>TAXONOMY<br/>LEVEL</b>                       | <b>CONTINUOUSASSESSMENT</b> |                          |                               | <b>ASSIGNMEN<br/>T</b> | <b>ATTENDANCE</b> | <b>END<br/>SEMESTER<br/>EXAMINATION</b> |
|                                                             | <b>CIA1<br/>(6Marks)</b>    | <b>CIA2<br/>(6Marks)</b> | <b>ModelExam<br/>(8Marks)</b> | <b>(10Marks)</b>       | <b>(10Marks)</b>  | <b>(60Marks)</b>                        |
| Remember                                                    |                             |                          |                               | <b>10</b>              | <b>10</b>         | <b>60</b>                               |
| Understand                                                  | 80                          |                          | 20                            |                        |                   |                                         |
| Apply                                                       | 20                          | 100                      | 80                            |                        |                   |                                         |
| Analyze                                                     |                             |                          |                               |                        |                   |                                         |
| Evaluate                                                    |                             |                          |                               |                        |                   |                                         |
| Create                                                      |                             |                          |                               |                        |                   |                                         |
| <b>Total<br/>(100Marks)</b>                                 | <b>6</b>                    | <b>6</b>                 | <b>8</b>                      | <b>10</b>              | <b>10</b>         | <b>60</b>                               |

- CIA1, CIA2 and ModelExam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| <b>COs/<br/>POs</b> | <b>PO<br/>1</b> | <b>PO<br/>2</b> | <b>PO<br/>3</b> | <b>PO<br/>4</b> | <b>PO<br/>5</b> | <b>PO<br/>6</b> | <b>PO<br/>7</b> | <b>PO<br/>8</b> | <b>PO<br/>9</b> | <b>PO<br/>10</b> | <b>PO<br/>11</b> | <b>PSO<br/>1</b> | <b>PSO<br/>2</b> | <b>PSO<br/>3</b> |
|---------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|------------------|
| CC502.1             | 3               | 2               | 1               | 1               | 2               | -               | -               | -               | -               | -                | 1                | 1                | 2                | 2                |
| CC502.2             | 3               | 2               | 2               | 1               | 3               | -               | -               | -               | -               | -                | 1                | 2                | 2                | 3                |
| CC502.3             | 2               | 2               | 2               | 1               | 3               | -               | -               | -               | -               | -                | 1                | 1                | 2                | 3                |
| CC502.4             | 2               | 2               | 3               | 1               | 3               | -               | -               | -               | -               | -                | 1                | 2                | 2                | 3                |
| CC502.5             | 2               | 2               | 2               | 1               | 2               | -               | -               | -               | -               | -                | 2                | 2                | 2                | 2                |

**1-low, 2-medium, 3-high, '-'-no correlation**

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CourseName                                                                                                             | Category               | Hours/Week                |   |   | C    |      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                        |                        | L                         | T | P |      |      |
| 24CC503                                                                                                                                                                                                                                                                                                                                                                                                                                                     | SOFTWARE TESTING AND AUTOMATION                                                                                        | PE                     | 3                         | 0 | 0 | 3    |      |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Nature of the Course                                                                                                   | Semester               | Data Book/Codes/Standards |   |   |      |      |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                        | THEORY                                                                                                                 | -                      | -----                     |   |   |      |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                        | Co-requisite Course(s) |                           |   |   |      |      |
| -                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                        | -                      |                           |   |   |      |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                        |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                           | To understand the basics of software testing.                                                                          |                        |                           |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                           | To learn how to do testing, plan and design.                                                                           |                        |                           |   |   |      |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                           | To learn how to execute the test cases.                                                                                |                        |                           |   |   |      |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                           | To focus on wide aspects of testing and understanding multiple facets of testing.                                      |                        |                           |   |   |      |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                           | To get an insight about the test automation and tools used for test automation.                                        |                        |                           |   |   |      |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                        |                        |                           |   |   |      |      |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                        |                        |                           |   |   |      |      |
| CC503.1                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Understand the basic concepts of software testing and the need for software testing.                                   |                        |                           |   |   | [U]  |      |
| CC503.2                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply concepts of test planning and test design for the software systems.                                              |                        |                           |   |   | [AP] |      |
| CC503.3                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply effective test cases that can uncover critical defects in the application.                                       |                        |                           |   |   | [AP] |      |
| CC503.4                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply the software systems using advanced testing methods.                                                             |                        |                           |   |   | [AP] |      |
| CC503.5                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Automate the software testing using Selenium and TestNG.                                                               |                        |                           |   |   | [AP] |      |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                        |                        |                           |   |   |      |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                      | INTRODUCTION                                                                                                           |                        |                           |   |   | C01  | 9Hrs |
| Need of software test- Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults, Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing. Test Strategies: Top-Down Testing, Bottom-Up Testing, Thread testing, Stress testing, Back-to-back testing; |                                                                                                                        |                        |                           |   |   |      |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                                                      | TEST PLANNING AND DESIGN                                                                                               |                        |                           |   |   | C02  | 9Hrs |
| TEST PLANNING: The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics. TEST DESIGN: Test Objective Identification, Test Design Factors & Requirements, Modeling a Test Design Process,                                                                                                    |                                                                                                                        |                        |                           |   |   |      |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                                                      | TEST EXECUTION                                                                                                         |                        |                           |   |   | C03  | 9Hrs |
| Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.                                                                                                                                                                 |                                                                                                                        |                        |                           |   |   |      |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ADVANCED TESTING CONCEPTS                                                                                              |                        |                           |   |   | C04  | 9Hrs |
| Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications.                                                                                                                                                                |                                                                                                                        |                        |                           |   |   |      |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                                                      | TEST AUTOMATION AND TOOLS                                                                                              |                        |                           |   |   | C05  | 9Hrs |
| Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web 120 Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports                                                                                                                                |                                                                                                                        |                        |                           |   |   |      |      |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                        |                        |                           |   |   | 45   |      |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                        |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Yogesh Singh, "Software Testing", Cambridge University Press, 2012.                                                    |                        |                           |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018.                        |                        |                           |   |   |      |      |
| Reference Books:                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                        |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc. |                        |                           |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Fourth Edition, 2014, Taylor & Francis Group.             |                        |                           |   |   |      |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Carl Cocchiario, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.                             |                        |                           |   |   |      |      |

|                       |                                                                                                                                                                             |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4                     | ElfriedeDustin,ThomGarrett,BernieGaurf,ImplementingAutomatedSoftwareTesting,2009, PearsonEducation, Inc.                                                                    |
| <b>WebReferences:</b> |                                                                                                                                                                             |
| 1                     | <a href="https://onlinecourses.nptel.ac.in/noc25_cs66/preview">https://onlinecourses.nptel.ac.in/noc25_cs66/preview</a>                                                     |
| 2                     | <a href="https://www.udemy.com/course/automation-testing-online-course-with-certificate">https://www.udemy.com/course/automation-testing-online-course-with-certificate</a> |

| AssessmentbasedonContinuousandEndSemesterExamination |                      |                  |                        |                         |                         |                                       |
|------------------------------------------------------|----------------------|------------------|------------------------|-------------------------|-------------------------|---------------------------------------|
| BLOOM'S LEVEL                                        | CONTINUOUSASSESSMENT |                  |                        | ASSIGNMENT<br>(10Marks) | ATTENDANCE<br>(10Marks) | END SEMESTER EXAMINATION<br>(60Marks) |
|                                                      | CIA1<br>(6MARKS)     | CIA2<br>(6MARKS) | MODEL EXAM<br>(8MARKS) |                         |                         |                                       |
| Remember                                             |                      |                  |                        | 10                      | 10                      | 60                                    |
| Understand                                           | 80                   |                  | 20                     |                         |                         |                                       |
| Apply                                                | 20                   | 100              | 80                     |                         |                         |                                       |
| Analyze                                              |                      |                  |                        |                         |                         |                                       |
| Evaluate                                             |                      |                  |                        |                         |                         |                                       |
| Create                                               |                      |                  |                        |                         |                         |                                       |
| <b>Total(100 Marks)</b>                              | <b>6</b>             | <b>6</b>         | <b>8</b>               | <b>10</b>               | <b>10</b>               | <b>60</b>                             |

- CIA1, CIA 2 andModelExamwillbeconductedfor 50, 50 and 100 marks.Itshallbesubsequentlyconvertedto 6, 6 and 8 marksrespectively.
- TheAssignment marks will be computed based on Assignment I, Assignment II and Assignment III marks convertedto10 Marks.
- BTLmarksplitupmayvarybasedonthenatureofthesubject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| CC503.1     | 3    | 3    | 2    | 1    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 2     | 3     |
| CC503.2     | 2    | 3    | 1    | 1    | 1    | -    | -    | -    | -    | -     | 2     | 1     | 2     | 3     |
| CC503.3     | 2    | 2    | 1    | 3    | 1    | -    | -    | -    | -    | -     | 2     | 2     | 3     | 2     |
| CC503.4     | 2    | 1    | 3    | 2    | 1    | -    | -    | -    | -    | -     | 3     | 3     | 1     | 2     |
| CC503.5     | 2    | 2    | 1    | 3    | 1    | -    | -    | -    | -    | -     | 1     | 2     | 1     | 3     |

1-low,2-medium,3-high,'-'-nocorrelation

| Course Code                                                                                                                                                                                                                                                                                                                                            | CourseName                                                                                                                                    | Category               | Hours/Week               |   |   | C    |      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------|---|---|------|------|
|                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                               |                        | L                        | T | P |      |      |
| 24CC504                                                                                                                                                                                                                                                                                                                                                | WEBAPPLICATIONSECURITY                                                                                                                        | PE                     | 3                        | 0 | 0 | 3    |      |
| Regulation                                                                                                                                                                                                                                                                                                                                             | NatureoftheCourse                                                                                                                             | Semester               | DataBook/Codes/Standards |   |   |      |      |
| 2024                                                                                                                                                                                                                                                                                                                                                   | THEORY                                                                                                                                        | -                      | -                        |   |   |      |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                               | Co- requisiteCourse(s) |                          |   |   |      |      |
| -                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                               | -                      |                          |   |   |      |      |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                               |                        |                          |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                                                      | To provide a strong foundation in the fundamental concepts and principles ofWeb ApplicationSecurity.                                          |                        |                          |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                                                      | Toenablelearnerstounderstandsecuredesignpracticesandtheimplementationofsecuritymec hanisms during web application development and deployment. |                        |                          |   |   |      |      |
| 3                                                                                                                                                                                                                                                                                                                                                      | Toimpartknowledge on designingand implementing secureApplication Programming Interfaces(APIs).                                                |                        |                          |   |   |      |      |
| 4                                                                                                                                                                                                                                                                                                                                                      | Tointroducethemethodologies,tools,andtechniquesusedinvulnerabilityassessmentandpenet ration testing.                                          |                        |                          |   |   |      |      |
| 5                                                                                                                                                                                                                                                                                                                                                      | Toacquire basic insight into ethical hacking techniques and commonly used security tools.                                                     |                        |                          |   |   |      |      |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                               |                        |                          |   |   |      |      |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                                                                         |                                                                                                                                               |                        |                          |   |   |      |      |
| CC504.1                                                                                                                                                                                                                                                                                                                                                | Understanding the fundamental concepts and principles ofweb application security.                                                             |                        |                          |   |   | [U]  |      |
| CC504.2                                                                                                                                                                                                                                                                                                                                                | Applysecuredesign and development practices in building anddeploying webapplications.                                                         |                        |                          |   |   | [AP] |      |
| CC504.3                                                                                                                                                                                                                                                                                                                                                | Develop and implement secure APIs by incorporating appropriate authentication andauthorization mechanisms.                                    |                        |                          |   |   | [AP] |      |
| CC504.4                                                                                                                                                                                                                                                                                                                                                | Apply vulnerability assessmentandpenetrationtestingtoolstodetectsecurityweaknesses in web applications.                                       |                        |                          |   |   | [AP] |      |
| CC504.5                                                                                                                                                                                                                                                                                                                                                | Demonstrate the use of securitytoolsand ethicalhacking techniquesto detectvulnerabilities and apply corrective actions.                       |                        |                          |   |   | [AP] |      |
| CourseContents                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                               |                        |                          |   |   |      |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                 | FUNDAMENTALSOFWEBAPPLICATIONSECURITY                                                                                                          |                        |                          |   |   | C01  | 9Hrs |
| ThehistoryofSoftwareSecurity- RecognizingWebApplicationSecurityThreats,WebApplicationSecurity,AuthenticationandAuthorization,Secure Socketlayer,TransportlayerSecurity,SessionManagement -Input Validation                                                                                                                                             |                                                                                                                                               |                        |                          |   |   |      |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                 | SECUREDEVELOPMENTANDDEPLOYMENT                                                                                                                |                        |                          |   |   | C02  | 9Hrs |
| WebApplicationsSecurity -SecurityTesting, Security IncidentResponsePlanning,TheMicrosoft SecurityDevelopmentLifecycle(SDL),OWASPComprehensiveLightweight ApplicationSecurityProcess(CLASP),TheSoftwareAssurance Maturity Model (SAMM)                                                                                                                  |                                                                                                                                               |                        |                          |   |   |      |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                 | SECUREAPIDEVELOPMENT                                                                                                                          |                        |                          |   |   | C03  | 9Hrs |
| APISecurity- SessionCookies, TokenBasedAuthentication, SecuringNatterAPIs:Addressingthreatswith Security Controls, Rate Limiting for Availability, Encryption, Audit logging,Securing service-to-service APIs: API Keys, OAuth2, SecuringMicroserviceAPIs: Service Mesh, LockingDownNetworkConnections, Securing IncomingRequests.                     |                                                                                                                                               |                        |                          |   |   |      |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                 | VULNERABILITYASSESSMENTANDPENETRATIONTESTING                                                                                                  |                        |                          |   |   | C04  | 9Hrs |
| Vulnerability AssessmentLifecycle, Vulnerability AssessmentTools:Cloud -based vulnerabilityscanners,Host-basedvulnerabilityscanners,Network- basedvulnerabilityscanners,Databasebasedvulnerabilityscanners,TypesofPenetrationTests:ExternalTestin g,WebApplicationTesting,InternalPenetrationTesting,SSIDor WirelessTesting, MobileApplicationTesting. |                                                                                                                                               |                        |                          |   |   |      |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                 | HACKINGTECHNIQUESANDTOOLS                                                                                                                     |                        |                          |   |   | C05  | 9Hrs |
| Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-SiteRequestForgery(CSRF), Web3.0Architectureandsecurity. SecurityMisconfiguration,Insecure Cryptographic Storage, Failureto Restrict URLAccess, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite,etc.                                  |                                                                                                                                               |                        |                          |   |   |      |      |
| TotalHours                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                               |                        |                          |   |   | 45   |      |
| Textbooks:                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                               |                        |                          |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                                                      | Andrew Hoffman, WebApplication Security: Exploitation and Countermeasures for ModernWeb                                                       |                        |                          |   |   |      |      |

|                         |                                                                                                                                                                                            |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | Applications, First Edition, 2020, O'Reilly Media, Inc.                                                                                                                                    |
| 2                       | Bryan Sullivan, Vincent Liu, Web Application Security: A Beginner's Guide, 2012, The McGraw-Hill Companies.                                                                                |
| 3                       | Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.                                                                                                              |
| <b>Reference Books:</b> |                                                                                                                                                                                            |
| 1                       | Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.                                                                                              |
| 2                       | Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.                                                                                       |
| 3                       | Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.                                                                                                                   |
| 4                       | Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies. |
| <b>Web References:</b>  |                                                                                                                                                                                            |
| 1                       | <a href="https://www.udemy.com/topic/web-application-security-tester/">https://www.udemy.com/topic/web-application-security-tester/</a>                                                    |
| 2                       | <a href="https://onlinecourses.nptel.ac.in/noc26_cs83/preview">https://onlinecourses.nptel.ac.in/noc26_cs83/preview</a>                                                                    |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 60                    |                | 20                   |            |            |                          |
| Apply                                                       | 40                    | 100            | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| CC504.1     | 1    | 2    | 2    | 1    | 3    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 3     |
| CC504.2     | 2    | 1    | 2    | 1    | 3    | -    | -    | -    | -    | -     | 2     | 2     | 2     | 3     |
| CC504.3     | 1    | 1    | 1    | 2    | 3    | -    | -    | -    | -    | -     | 1     | 2     | 3     | 3     |
| CC504.4     | 1    | 2    | 1    | 1    | 2    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 3     |
| CC504.5     | 1    | 2    | 2    | 2    | 2    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Course Name                                                                                                                  | Category               | Hours/Week                |   |     | C    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-----|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                              |                        | L                         | T | P   |      |
| 24CC505                                                                                                                                                                                                                                                                                                                                                                                                                                                               | PRINCIPLES OF PROGRAMMING LANGUAGES                                                                                          | PE                     | 3                         | 0 | 0   | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Nature of the Course                                                                                                         | Semester               | Data Book/Codes/Standards |   |     |      |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | THEORY                                                                                                                       | -                      | -                         |   |     |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                              | Co-requisite Course(s) |                           |   |     |      |
| Programming in C ,Object Oriented Programming and Java                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                              | -                      |                           |   |     |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                              |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | To comprehend and explain the syntax and semantics of programming languages.                                                 |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | To gain knowledge of data, data types, and fundamental programming statements.                                               |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | To understand the call-return mechanism and various approaches to its implementation.                                        |                        |                           |   |     |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | To acquire knowledge of object-oriented concepts, concurrency, and event-driven programming in modern languages.             |                        |                           |   |     |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | To develop programs using non-procedural programming paradigms.                                                              |                        |                           |   |     |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                              |                        |                           |   |     |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                              |                        |                           |   |     |      |
| CC505.1                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Describe syntax and semantics of programming languages                                                                       |                        |                           |   |     | [U]  |
| CC505.2                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Implements suitable data types and basic programming constructs in solving computational problems.                           |                        |                           |   |     | [AP] |
| CC505.3                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Apply call-return mechanisms and their implementation techniques in programming languages.                                   |                        |                           |   |     | [AP] |
| CC505.4                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Apply object-oriented, concurrency, and event handling programming constructs and develop programs in Scheme, ML, and Prolog |                        |                           |   |     | [AP] |
| CC505.5                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Develop programs using non-procedural programming paradigms.                                                                 |                        |                           |   |     | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                              |                        |                           |   |     |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                | SYNTAX AND SEMANTICS                                                                                                         |                        |                           |   | C01 | 9Hrs |
| Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing                                                                                                                                                                                                                                                                       |                                                                                                                              |                        |                           |   |     |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                | DATA, DATA TYPES, AND BASIC STATEMENTS                                                                                       |                        |                           |   | C02 | 9Hrs |
| Names – variables – binding – type checking – scope – scoperules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control structures – selection – iterations – branching – guarded statements |                                                                                                                              |                        |                           |   |     |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                | SUBPROGRAMS AND IMPLEMENTATIONS                                                                                              |                        |                           |   | C03 | 9Hrs |
| Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping                                                                                                                                                                         |                                                                                                                              |                        |                           |   |     |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                | OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING                                                                          |                        |                           |   | C04 | 9Hrs |
| Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling                                                                                                                                                                                                                             |                                                                                                                              |                        |                           |   |     |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                | FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES                                                                                   |                        |                           |   | C05 | 9Hrs |
| Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages                                                                                                                                                                                                                                 |                                                                                                                              |                        |                           |   |     |      |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                              |                        |                           |   | 45  |      |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                              |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Robert W. Sebesta, "Concepts of Programming Languages", Twelfth Edition (Global Edition), Pearson, 2022.                     |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Michael L. Scott, "Programming Language Pragmatics", Fourth Edition, Elsevier, 2018.                                         |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | R. Kent Dybvig, "The Scheme programming language", Fourth Edition, Prentice Hall, 2011.                                      |                        |                           |   |     |      |
| Reference Books:                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                              |                        |                           |   |     |      |

|                        |                                                                                                                         |
|------------------------|-------------------------------------------------------------------------------------------------------------------------|
| 1                      | Jeffrey D. Ullman, "Elements of ML programming", Second Edition, Pearson, 1997.                                         |
| 2                      | W. F. Clocksin and C. S. Mellish, "Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003.       |
| 3                      | Programming Languages: Principles and Paradigms – Maurizio Gabbriellini & Simone Martini, 2010.                         |
| 4                      | Concepts in Programming Languages – John C. Mitchell, Cambridge University, 2002 (first edition).                       |
| <b>Web References:</b> |                                                                                                                         |
| 1                      | <a href="https://www.nptel.ac.in/courses/106102067">https://www.nptel.ac.in/courses/106102067</a> .                     |
| 2                      | <a href="https://www.nptelprep.in/courses/106102067/materials">https://www.nptelprep.in/courses/106102067/materials</a> |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 60                    |                | 20                   |            |            |                          |
| Apply                                                       | 40                    | 100            | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| CC505.1     | 2    | 2    | 3    | 2    | 1    | -    | -    | -    | -    | -     | 3     | 2     | 3     | 2     |
| CC505.2     | 3    | 3    | 3    | 2    | 2    | -    | -    | -    | -    | -     | 3     | 2     | 3     | 3     |
| CC505.3     | 3    | 3    | 3    | 2    | 2    | -    | -    | -    | -    | -     | 3     | 2     | 3     | 3     |
| CC505.4     | 3    | 3    | 3    | 3    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 2     | 2     |
| CC505.5     | 3    | 3    | 3    | 3    | 3    | -    | -    | -    | -    | -     | 3     | 3     | 3     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                     | CourseName                                                                                                                         | Category              | Hours/Week               |   |   | C    |   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|---|------|---|
|                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                    |                       | L                        | T | P |      |   |
| 24CC506                                                                                                                                                                                                                                                                                                                                                                                                                         | ADVANCEDDATABASES                                                                                                                  | PE                    | 3                        | 0 | 0 | 3    |   |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                      | NatureoftheCourse                                                                                                                  | Semester              | DataBook/Codes/Standards |   |   |      |   |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                            | THEORY                                                                                                                             | -                     | -                        |   |   |      |   |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                    | Co-requisiteCourse(s) |                          |   |   |      |   |
| Database Management Systems                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                    | -                     |                          |   |   |      |   |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                    |                       |                          |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                               | To provide knowledge on parallel and distributed database architectures.                                                           |                       |                          |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                               | To introduce intelligent database concepts and their applications.                                                                 |                       |                          |   |   |      |   |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                               | To apply XML data models, XML querying, and graphdatabase conceptsfor managing semi-structured and connected data.                 |                       |                          |   |   |      |   |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                               | To know the challenges and techniques involved in mobile database management.                                                      |                       |                          |   |   |      |   |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                               | To impartknowledge onmultimedia database design,multidimensional data structures, andemerging database technologies.               |                       |                          |   |   |      |   |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                    |                       |                          |   |   |      |   |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                    |                       |                          |   |   |      |   |
| CC506.1                                                                                                                                                                                                                                                                                                                                                                                                                         | Understandvarious database system architectures and other concepts relatedto it.                                                   |                       |                          |   |   | [U]  |   |
| CC506.2                                                                                                                                                                                                                                                                                                                                                                                                                         | Applyintelligentdatabaseconceptsandspatialdatabasemodelsinreal-worldapplications.                                                  |                       |                          |   |   | [AP] |   |
| CC506.3                                                                                                                                                                                                                                                                                                                                                                                                                         | Evaluate XML and graph database models for managing semi-structured and connecteddata in comparison with relational databases.     |                       |                          |   |   | [AP] |   |
| CC506.4                                                                                                                                                                                                                                                                                                                                                                                                                         | Apply themobile database management issuesincluding mobility impact, transactionmodels, concurrency control, and commit protocols. |                       |                          |   |   | [AP] |   |
| CC506.5                                                                                                                                                                                                                                                                                                                                                                                                                         | Apply multimedia database systems using multidimensional data structures for image,text, audio, and video data.                    |                       |                          |   |   | [AP] |   |
| CourseContents                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                    |                       |                          |   |   |      |   |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                          | PARALLELANDDDISTRIBUTEDDATABASES                                                                                                   |                       |                          |   |   | C01  | 9 |
| DatabaseSystemArchitectures:CentralizedandClient-ServerArchitectures-ServerSystemArchitectures-Parallel Systems- Distributed Systems - Parallel Databases: I/O Parallelism -Inter andIntraQueryParallelism-InterandIntraoperationParallelism-Designof ParallelSystemsDistributedDatabaseConcepts-DistributedDataStorage-DistributedTransactions-CommitProtocols-Concurrency Control- DistributedQuery Processing - Case Studies |                                                                                                                                    |                       |                          |   |   |      |   |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                          | INTELLIGENTDATABASES                                                                                                               |                       |                          |   |   | C02  | 9 |
| Active Databases: Syntax and Semantics (Starburst, Oracle, DB2) - Taxonomy- Applications- Design Principles forActiveRules-TemporalDatabases:OverviewofTemporalDatabasesTSQL2-DeductiveDatabases-RecursiveQueriesinSQL-SpatialDatabases-SpatialDataTypes-SpatialRelationships-SpatialDataStructures-Spatial AccessMethods- SpatialDBImplementation.                                                                             |                                                                                                                                    |                       |                          |   |   |      |   |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                          | XMLANDGRAPHDATABASES                                                                                                               |                       |                          |   |   | C03  | 9 |
| XMLDatabases:XMLDataModel-DTD-XMLSchema-XMLQuerying-WebDatabases-OpenDatabase Connectivity.GraphDatabases: Introduction-Comparisonwithrelationalmodeling,GraphDatabases,Consistency, Transactions, Availability,Query Features,Scaling.                                                                                                                                                                                         |                                                                                                                                    |                       |                          |   |   |      |   |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                          | MOBILEDATABASES                                                                                                                    |                       |                          |   |   | C04  | 9 |
| MobileDatabases:LocationandHandoffManagement -EffectofMobilityonDataManagement-Location DependentDataDistribution - MobileTransactionModels - ConcurrencyControl-TransactionCommitProtocols                                                                                                                                                                                                                                     |                                                                                                                                    |                       |                          |   |   |      |   |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                          | MULTIMEDIADATABASESANDEMERGINGDATABASETECHNOLOGIES                                                                                 |                       |                          |   |   | C05  | 9 |
| Multidimensional Data Structures - Image Databases - Text /Document Databases- VideoDatabases-AudioDatabases - Multimedia Database Design.Emerging Technologies: Active database - Detective database-Objectdatabase - Temporal database - Streaming databases.                                                                                                                                                                 |                                                                                                                                    |                       |                          |   |   |      |   |
| TotalHours                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                    |                       |                          |   |   | 45   |   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                    |                       |                          |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                               | AbrahamSilberschatz, HenryF. Korth, S. Sudharshan, "DatabaseSystemConcepts", SeventhEdition, TataMcGrawHill,2019.                  |                       |                          |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                               | RamezElmasri, Shamkant B. Navathe, "Fundamentals ofDatabase Systems", Seventh Edition, PearsonEducation, 2016.                     |                       |                          |   |   |      |   |

|                        |                                                                                                                                                                                         |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3                      | C.J.Date,A.Kannan, S.Swamynathan, —AnIntroductiontoDatabaseSystems, EighthEdition, PearsonEducation, 2006                                                                               |
| <b>ReferenceBooks:</b> |                                                                                                                                                                                         |
| 1                      | RaghuRamakrishnan, DatabaseManagementSystems,,4thedition, Mcgraw-Hill,2015                                                                                                              |
| 2                      | CarloZaniolo, StefanoCeri, ChristosFaloutsos, RichardT.Snodgrass,V.S.Subrahmanian, Roberto Zicari, —AdvancedDatabaseSystems, MorganKaufmannpublishers,2006.                             |
| 3                      | VijayKumar, —MobileDatabaseSystems, JohnWiley&Sons, 2006.                                                                                                                               |
| 4                      | S.K.Singh, DatabaseSystems: Concepts, Design&Applications, 2ndEdition,Pearsoneducation,2011.                                                                                            |
| <b>WebReferences:</b>  |                                                                                                                                                                                         |
| 1                      | <a href="https://www.coursera.org/learn/modern-databases-odc?utm_source=chatgpt.com">https://www.coursera.org/learn/modern-databases-odc?utm_source=chatgpt.com</a>                     |
| 2                      | <a href="https://www.udemy.com/course/certified-nosql-graph-databases/?utm_source=chatgpt.com">https://www.udemy.com/course/certified-nosql-graph-databases/?utm_source=chatgpt.com</a> |

| AssessmentbasedonContinuousandEndSemesterExamination |                      |                  |                       |            |            |                                |
|------------------------------------------------------|----------------------|------------------|-----------------------|------------|------------|--------------------------------|
| BLOOM'S<br>TAXONOMY<br>LEVEL                         | CONTINUOUSASSESSMENT |                  |                       | ASSIGNMENT | ATTENDANCE | END<br>SEMESTER<br>EXAMINATION |
|                                                      | CIA1<br>(6Marks)     | CIA2<br>(6Marks) | ModelExam<br>(8Marks) | (10Marks)  | (10Marks)  | (60Marks)                      |
| Remember                                             |                      |                  |                       | 10         | 10         | 60                             |
| Understand                                           | 80                   |                  | 20                    |            |            |                                |
| Apply                                                | 20                   | 100              | 80                    |            |            |                                |
| Analyze                                              |                      |                  |                       |            |            |                                |
| Evaluate                                             |                      |                  |                       |            |            |                                |
| Create                                               |                      |                  |                       |            |            |                                |
| <b>Total<br/>(100Marks)</b>                          | <b>6</b>             | <b>6</b>         | <b>8</b>              | <b>10</b>  | <b>10</b>  | <b>60</b>                      |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PSO<br>2 | PSO<br>3 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|
| CC506.1     | 3       | 3       | 2       | 2       | 3       | -       | -       | -       | -       | -        | 2        | 3        | 2        | 2        |
| CC506.2     | 3       | 2       | 3       | 2       | 3       | -       | -       | -       | -       | -        | 1        | 3        | 2        | 3        |
| CC506.3     | 3       | 3       | 2       | 2       | 3       | -       | -       | -       | -       | -        | 2        | 3        | 2        | 3        |
| CC506.4     | 3       | 3       | 2       | 2       | 3       | -       | -       | -       | -       | -        | 2        | 2        | 3        | 2        |
| CC506.5     | 3       | 2       | 3       | 2       | 3       | -       | -       | -       | -       | -        | 1        | 3        | 2        | 3        |

1-low,2-medium,3-high,'-'-no correlation

**VERTICAL III**  
**CLOUD COMPUTING AND DATA CENTER**  
**TECHNOLOGIES**

| Course Code                                                                                                                                                                                                                                                                                                                    | CourseName                                                                                                          | Category              | Hours/Week               |   |            | C    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|------------|------|
|                                                                                                                                                                                                                                                                                                                                |                                                                                                                     |                       | L                        | T | P          |      |
| 24CS507                                                                                                                                                                                                                                                                                                                        | DATA WAREHOUSING                                                                                                    | PE                    | 3                        | 0 | 0          | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                     | NatureoftheCourse                                                                                                   | Semester              | DataBook/Codes/Standards |   |            |      |
| 2024                                                                                                                                                                                                                                                                                                                           | Theory                                                                                                              | -                     | -                        |   |            |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                         |                                                                                                                     | Co-requisiteCourse(s) |                          |   |            |      |
| Database Management Systems                                                                                                                                                                                                                                                                                                    |                                                                                                                     | -                     |                          |   |            |      |
| CourseObjectives                                                                                                                                                                                                                                                                                                               |                                                                                                                     |                       |                          |   |            |      |
| 1                                                                                                                                                                                                                                                                                                                              | To knowthe details ofdata warehouse Architecture                                                                    |                       |                          |   |            |      |
| 2                                                                                                                                                                                                                                                                                                                              | To understand the OLAP Technology                                                                                   |                       |                          |   |            |      |
| 3                                                                                                                                                                                                                                                                                                                              | To understand the partitioning strategy                                                                             |                       |                          |   |            |      |
| 4                                                                                                                                                                                                                                                                                                                              | To differentiate various schema                                                                                     |                       |                          |   |            |      |
| 5                                                                                                                                                                                                                                                                                                                              | To understand the roles ofprocess manager & system manager                                                          |                       |                          |   |            |      |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                 |                                                                                                                     |                       |                          |   |            |      |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                                                 |                                                                                                                     |                       |                          |   |            |      |
| C507.1                                                                                                                                                                                                                                                                                                                         | Explain the concepts, components, and architecture ofa datawarehouseincludingmodernandautonomous data warehouses.   |                       |                          |   |            | [U]  |
| C507.2                                                                                                                                                                                                                                                                                                                         | Illustrate ETL processes and analyze OLAP technologies and theiroperationsindatawarehousingsystems.                 |                       |                          |   |            | [U]  |
| C507.3                                                                                                                                                                                                                                                                                                                         | Apply metadata management concepts, design data marts, and implement partitioningstrategiesindata warehouse design. |                       |                          |   |            | [AP] |
| C507.4                                                                                                                                                                                                                                                                                                                         | Apply dimensional modeling techniques and designschemas for efficientdata warehouseimplementation.                  |                       |                          |   |            | [AP] |
| C507.5                                                                                                                                                                                                                                                                                                                         | Frame roles ofprocess manager & system manager                                                                      |                       |                          |   |            | [AP] |
| CourseContents                                                                                                                                                                                                                                                                                                                 |                                                                                                                     |                       |                          |   |            |      |
| Unit-1                                                                                                                                                                                                                                                                                                                         | INTRODUCTION TO DATA WAREHOUSE                                                                                      |                       |                          |   | C01        | 9    |
| DatawarehouseIntroduction-Datawarehousecomponents-operationaldatabaseVsdatawarehouse – Data warehouseArchitecture – Three-tier Data Warehouse Architecture – AutonomousDataWarehouse- AutonomousDataWarehouseVsSnowflake – Modern Data Warehouse-Data Warehouse Administration AndManagement-Typesof distributed DataWarehouse |                                                                                                                     |                       |                          |   |            |      |
| Unit-2                                                                                                                                                                                                                                                                                                                         | ETL AND OLAP TECHNOLOGY                                                                                             |                       |                          |   | C02        | 9    |
| WhatisETL-ETLVsELT-Typesof Datawarehouses-DatawarehouseDesignandModeling-DeliveryProcess-Online Analytical Processing (OLAP) – Characteristics ofOLAP – OLAP Guidelines-Online Transaction Processing(OLTP) Vs OLAP – OLAP operations- Types ofOLAP-ROLAPVs MOLAPVsHOLAP- OLAPToolsandInternert-TheData warehouse and theweb.  |                                                                                                                     |                       |                          |   |            |      |
| Unit-3                                                                                                                                                                                                                                                                                                                         | METADATA, DATA MART AND PARTITION STRATEGIES                                                                        |                       |                          |   | C03        | 9    |
| MetaData –Categoriesof Metadata–Roleof Metadata–MetadataRepository –MetadataManagement- ChallengesforMeta Management – Data Mart – Need ofData Mart- Cost Effective Data Mart- Designing Data Marts- Cost ofData Marts-Partitioning Strategy – Vertical partition – Normalization – Row Splitting – Horizontal Partition       |                                                                                                                     |                       |                          |   |            |      |
| Unit-4                                                                                                                                                                                                                                                                                                                         | DIMENSIONAL MODELING AND SCHEMA                                                                                     |                       |                          |   | C04        | 9    |
| DimensionalModeling–Multi-DimensionalDataModeling – DataCube- StarSchema- Snowflakeschema- StarVs Snowflakeschema- Fact constellationSchema-Schema Definition- Process Architecture- TypesofDataBaseParallelism– Data warehouse Tools                                                                                          |                                                                                                                     |                       |                          |   |            |      |
| Unit-5                                                                                                                                                                                                                                                                                                                         | SYSTEM & PROCESS MANAGERS                                                                                           |                       |                          |   | C05        | 9    |
| DataWarehousing System Managers: System Configuration Manager- System Scheduling Manager – System EventManager-System DatabaseManager-System BackupRecovery Manager- DataWarehousingProcessManagers:LoadManager – Warehouse Manager- Query Manager – Hardware Architecture-Physical Layout-Security-Tuning – Testing           |                                                                                                                     |                       |                          |   |            |      |
|                                                                                                                                                                                                                                                                                                                                |                                                                                                                     |                       |                          |   | TotalHours | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                     |                                                                                                                     |                       |                          |   |            |      |



|                         |                                                                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1                       | Alejandro Vaisman and Esteban Zimányi, Data Warehouse Systems: Design and Implementation, Springer, 2022.                                    |
| 2                       | Ralph Kimball, "The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling", Third edition, 2013.                                |
| <b>Reference Books:</b> |                                                                                                                                              |
| 1                       | Paul Raj Ponniah, "Data warehousing fundamentals for IT Professionals", 2012.                                                                |
| 2                       | K. P. Soman, Shyam Diwakar and V. Ajay "Insight into Data Mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006. |
| 3                       | W. H. Inmon, "DW 2.0: The Architecture for the Next Generation of Data Warehousing Morgan Kaufmann (Elsevier)", 2008                         |
| 4                       | William H. Inmon, "Building The Data Warehouse", 2005                                                                                        |
| <b>Web References:</b>  |                                                                                                                                              |
| 1                       | <a href="https://www.acte.in/data-warehouse-basics-for-beginners">https://www.acte.in/data-warehouse-basics-for-beginners</a>                |
| 2                       | <a href="https://holowczak.com/introduction-data-warehousing">https://holowczak.com/introduction-data-warehousing</a>                        |

#### Assessment based on Continuous and End Semester Examination

| BLOOM'S TAXONOMY LEVEL   | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|--------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
|                          | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                 |                       |                |                      |            |            |                          |
| Understand               | 100                   | 20             | 20                   |            |            |                          |
| Apply                    |                       | 80             | 80                   |            |            |                          |
| Analyze                  |                       |                |                      |            |            |                          |
| Evaluate                 |                       |                |                      |            |            |                          |
| Create                   |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>Pos | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C507.1      | 3    | 2    |      |      | 1    |      |      |      |      |       | 1     | 2     | 1     |
| C507.2      | 3    | 3    |      | 1    | 2    |      |      |      |      |       |       | 2     | 2     |
| C507.3      | 2    | 3    | 3    | 1    | 2    |      |      |      |      |       |       | 3     | 2     |
| C507.4      | 2    | 2    | 3    | 1    | 2    |      |      |      |      |       |       | 3     | 3     |
| C507.5      | 1    | 2    | 2    | 1    | 2    |      |      |      | 2    | 2     | 1     | 2     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                 | Course Name                                                                                                                                     | Category               | Hours/Week                |   |     | C    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-----|------|
|                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                 |                        | L                         | T | P   |      |
| 24CS502                                                                                                                                                                                                                                                                                                                                                                                     | CLOUD SERVICES MANAGEMENT                                                                                                                       | PE                     | 3                         | 0 | 0   | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                  | Nature of the Course                                                                                                                            | Semester               | Data Book/Codes/Standards |   |     |      |
| 2024                                                                                                                                                                                                                                                                                                                                                                                        | THEORY                                                                                                                                          | -                      | -                         |   |     |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                 | Co-requisite Course(s) |                           |   |     |      |
| Operating Systems, Database management system                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                 | -                      |                           |   |     |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                 |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                           | Introduce Cloud Service Management terminology, definition & concepts                                                                           |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                           | Compare and contrast cloud service management with traditional IT service management                                                            |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                           | Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services                                              |                        |                           |   |     |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                           | Select appropriate structures for designing, deploying and running cloud-based services in a business environment                               |                        |                           |   |     |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                           | Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems                                             |                        |                           |   |     |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                 |                        |                           |   |     |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                 |                        |                           |   |     |      |
| C501.1                                                                                                                                                                                                                                                                                                                                                                                      | Explain the fundamental concepts of cloud service management including cloud ecosystem, characteristics, service models, and deployment models. |                        |                           |   |     | [U]  |
| C501.2                                                                                                                                                                                                                                                                                                                                                                                      | Describe cloud service strategies and management frameworks for effective adoption and implementation of cloud services.                        |                        |                           |   |     | [U]  |
| C501.3                                                                                                                                                                                                                                                                                                                                                                                      | Apply cloud service management techniques such as service lifecycle, capacity planning, migration, and operational management.                  |                        |                           |   |     | [AP] |
| C501.4                                                                                                                                                                                                                                                                                                                                                                                      | Apply cloud service economic models to analyze pricing strategies, billing mechanisms, and cost management in cloud environments.               |                        |                           |   |     | [AP] |
| C50.5                                                                                                                                                                                                                                                                                                                                                                                       | Demonstrate cloud governance frameworks and risk management practices to evaluate the value and effectiveness of cloud services.                |                        |                           |   |     | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                 |                        |                           |   |     |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                      | CLOUD SERVICE MANAGEMENT FUNDAMENTALS                                                                                                           |                        |                           |   | C01 | 9    |
| Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models Cloud Computing Architecture-Virtualization Technologies-Cloud Service Level Agreements (SLA) and Quality of Service (QoS)                                                    |                                                                                                                                                 |                        |                           |   |     |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                      | CLOUD SERVICES STRATEGY                                                                                                                         |                        |                           |   | C02 | 9    |
| Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture- Cloud Governance- Cloud Migration Strategy- Cloud Security Management- Cloud Service Level Agreement (SLA) - Cloud Resource Allocation |                                                                                                                                                 |                        |                           |   |     |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                      | CLOUD SERVICE MANAGEMENT                                                                                                                        |                        |                           |   | C03 | 9    |
| Cloud Service Reference Model, Cloud Service Life Cycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management-Cloud Governance and Compliance-Cloud Design Patterns                                    |                                                                                                                                                 |                        |                           |   |     |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                      | CLOUD SERVICE ECONOMICS                                                                                                                         |                        |                           |   | C04 | 9    |
| Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models-Cloud Service Billing and Metering-Cloud Financial Management-Resource Allocation and Cost Efficiency                                                                      |                                                                                                                                                 |                        |                           |   |     |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                      | CLOUD SERVICE GOVERNANCE & VALUE                                                                                                                |                        |                           |   | C05 | 9    |

|                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ITGovernanceDefinition, CloudGovernanceDefinition, CloudGovernanceFramework, CloudGovernance Structure, Cloud Governance Considerations, Cloud Service ModelRiskMatrix, Understanding Valueof CloudServices, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership- Cloud Cost<br>Management and Optimization-Cloud Security and Risk Management |                                                                                                                                                                                                                                               |
| <b>TotalHours</b>                                                                                                                                                                                                                                                                                                                                                             | <b>45</b>                                                                                                                                                                                                                                     |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                               |
| 1                                                                                                                                                                                                                                                                                                                                                                             | Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications, 2023                                                                                                                       |
| 2                                                                                                                                                                                                                                                                                                                                                                             | Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2024                                                                                                                                    |
| <b>ReferenceBooks:</b>                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                               |
| 1                                                                                                                                                                                                                                                                                                                                                                             | James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.                                                                                                                 |
| 2                                                                                                                                                                                                                                                                                                                                                                             | Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.                                                                                 |
| <b>WebReferences:</b>                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                               |
| 1                                                                                                                                                                                                                                                                                                                                                                             | <a href="https://www.startertutorials.com/blog/cloud-computing-essentials.html">https://www.startertutorials.com/blog/cloud-computing-essentials.html</a>                                                                                     |
| 2                                                                                                                                                                                                                                                                                                                                                                             | <a href="https://www.linkedin.com/top-content/training-development/digital-literacy-training/cloud-computing-essentials/">https://www.linkedin.com/top-content/training-development/digital-literacy-training/cloud-computing-essentials/</a> |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 100                   | 20             | 20                   |            |            |                          |
| Apply                                                       |                       | 80             | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P010 | P011 | PS01 | PS02 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C502.1      | 3   | 2   |     |     | 2   |     |     |     |     |      | 1    | 2    | 3    |
| C502.2      | 3   | 3   | 1   |     | 2   |     |     |     |     | 1    | 1    | 2    | 3    |
| C502.3      | 2   | 2   | 3   | 1   | 3   |     |     |     |     | 2    | 1    | 3    | 3    |
| C502.4      | 1   | 3   | 1   |     | 2   |     |     |     |     | 3    | 1    | 3    | 2    |
| C502.5      | 1   | 2   | 1   | 1   | 2   | 3   | 2   |     |     | 1    | 2    | 1    | 2    |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                        | Course Name                                                                                                                      | Category               | Hours/Week                |   |   | C    |      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|------|
|                                                                                                                                                                                                                                                                                                                    |                                                                                                                                  |                        | L                         | T | P |      |      |
| 24CS503                                                                                                                                                                                                                                                                                                            | VIRTUALIZATION                                                                                                                   | PE                     | 3                         | 0 | 0 | 3    |      |
| Regulation                                                                                                                                                                                                                                                                                                         | Nature of the Course                                                                                                             | Semester               | Data Book/Codes/Standards |   |   |      |      |
| R24                                                                                                                                                                                                                                                                                                                | Theory                                                                                                                           | -                      | -                         |   |   |      |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                            |                                                                                                                                  | Co-requisite Course(s) |                           |   |   |      |      |
| Foundation of Cloud Computing                                                                                                                                                                                                                                                                                      |                                                                                                                                  | Computer Networks      |                           |   |   |      |      |
| Course Objectives                                                                                                                                                                                                                                                                                                  |                                                                                                                                  |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                  | To understand the fundamentals and need for virtualization in modern computing.                                                  |                        |                           |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                  | To explore server and desktop virtualization techniques and their applications.                                                  |                        |                           |   |   |      |      |
| 3                                                                                                                                                                                                                                                                                                                  | To learn concepts and tools related to network virtualization.                                                                   |                        |                           |   |   |      |      |
| 4                                                                                                                                                                                                                                                                                                                  | To understand storage and memory virtualization techniques.                                                                      |                        |                           |   |   |      |      |
| 5                                                                                                                                                                                                                                                                                                                  | To analyze security challenges and solutions in virtualization environments.                                                     |                        |                           |   |   |      |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                    |                                                                                                                                  |                        |                           |   |   |      |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                            |                                                                                                                                  |                        |                           |   |   |      |      |
| C503.1                                                                                                                                                                                                                                                                                                             | Explain the fundamentals, need, and types of virtualization.                                                                     |                        |                           |   |   | [U]  |      |
| C503.2                                                                                                                                                                                                                                                                                                             | Analyze server and desktop virtualization techniques and their applications.                                                     |                        |                           |   |   | [AP] |      |
| C503.3                                                                                                                                                                                                                                                                                                             | Understand and apply network virtualization concepts and tools.                                                                  |                        |                           |   |   | [AP] |      |
| C503.4                                                                                                                                                                                                                                                                                                             | Apply storage and memory virtualization techniques to configure and manage efficient storage systems in real-world environments. |                        |                           |   |   | [AP] |      |
| C503.5                                                                                                                                                                                                                                                                                                             | Apply security issues and implement protection mechanisms in virtualization environments.                                        |                        |                           |   |   | [AP] |      |
| Course Contents                                                                                                                                                                                                                                                                                                    |                                                                                                                                  |                        |                           |   |   |      |      |
| Unit-1                                                                                                                                                                                                                                                                                                             | INTRODUCTION TO VIRTUALIZATION                                                                                                   |                        |                           |   |   | C01  | 9Hrs |
| Virtualization and cloud computing - Need of virtualization - cost, administration, fast deployment, reduce infrastructure cost - limitations - Types of hardware virtualization: Full virtualization - partial virtualization - Paravirtualization - Types of Hypervisors.                                        |                                                                                                                                  |                        |                           |   |   |      |      |
| Unit-2                                                                                                                                                                                                                                                                                                             | SERVER AND DESKTOP VIRTUALIZATION                                                                                                |                        |                           |   |   | C02  | 9Hrs |
| Virtual machine basics - Types of virtual machines - Understanding Server Virtualization - types of server virtualization - Business Cases for Server Virtualization - Uses of Virtual Server Consolidation - Selecting Server Virtualization Platform - Desktop Virtualization - Types of Desktop Virtualization. |                                                                                                                                  |                        |                           |   |   |      |      |
| Unit-3                                                                                                                                                                                                                                                                                                             | NETWORK VIRTUALIZATION                                                                                                           |                        |                           |   |   | C03  | 9Hrs |
| Introduction to Network Virtualization - Advantages - Functions - Tools for Network Virtualization - VLAN - WAN Architecture - WAN Virtualization.                                                                                                                                                                 |                                                                                                                                  |                        |                           |   |   |      |      |
| Unit-4                                                                                                                                                                                                                                                                                                             | STORAGE VIRTUALIZATION                                                                                                           |                        |                           |   |   | C04  | 9Hrs |
| Memory Virtualization - Types of Storage Virtualization - Block, File - Address space Remapping - Risks of Storage Virtualization - SAN - NAS - RAID.                                                                                                                                                              |                                                                                                                                  |                        |                           |   |   |      |      |
| Unit-5                                                                                                                                                                                                                                                                                                             | VIRTUALIZATION SECURITY                                                                                                          |                        |                           |   |   | C05  | 9Hrs |
| Fundamentals of Virtualization Security - Securing Hypervisors - Designing Virtual networks for security - comparing virtual and physical networks - Security recommendations for management platforms - virtual machine threats and vulnerabilities - logging and auditing.                                       |                                                                                                                                  |                        |                           |   |   |      |      |
| Total Hours                                                                                                                                                                                                                                                                                                        |                                                                                                                                  |                        |                           |   |   | 45   |      |
| Textbooks:                                                                                                                                                                                                                                                                                                         |                                                                                                                                  |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                  | William von Hagen, <i>Professional Xen Virtualization</i> , Wiley Publishing.                                                    |                        |                           |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                  | Chris Wolf and Erick M. Halter, <i>Virtualization: From the Desktop to the Enterprise</i> , Apress.                              |                        |                           |   |   |      |      |
| Reference Books:                                                                                                                                                                                                                                                                                                   |                                                                                                                                  |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                  | James E. Smith and Ravi Nair, <i>Virtual Machines: Versatile Platforms for Systems and Processes</i> , Morgan Kaufmann.          |                        |                           |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                  | Bernard Golden, <i>Virtualization for Dummies</i> , Wiley Publishing.                                                            |                        |                           |   |   |      |      |
| Web References:                                                                                                                                                                                                                                                                                                    |                                                                                                                                  |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                  | <a href="https://www.vmware.com">https://www.vmware.com</a>                                                                      |                        |                           |   |   |      |      |

|   |                                                                                                                   |
|---|-------------------------------------------------------------------------------------------------------------------|
| 2 | <a href="https://learn.microsoft.com/en-us/virtualization/">https://learn.microsoft.com/en-us/virtualization/</a> |
|---|-------------------------------------------------------------------------------------------------------------------|

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         |                          |
| Understand                                                  | 20                    | 20             | 20                   |            |            |                          |
| Apply                                                       | 80                    | 80             | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/ POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|----------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C503.1   | 3    | 2    | -    | -    | 2    | -    | -    | -    | -    | -     | 2     | 2     | -     |
| C503.2   | 3    | 3    | 2    | 2    | 3    | -    | -    | 2    | -    | -     | 2     | 3     | 2     |
| C503.3   | 3    | 3    | 3    | 2    | 3    | -    | -    | 2    | -    | -     | 2     | 3     | 2     |
| C503.4   | 3    | 2    | 2    | 2    | 3    | -    | -    | -    | -    | -     | 2     | 3     | 2     |
| C503.5   | 3    | 3    | 2    | 3    | 3    | 2    | 2    | 2    | 2    | -     | 2     | 3     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Course Name                                                                    | Category               | Hours/Week                |   |   | C    |      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                |                        | L                         | T | P |      |      |
| 24CS504                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Security And Privacy in Cloud                                                  | PE                     | 3                         | 0 | 0 | 3    |      |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Nature of the Course                                                           | Semester               | Data Book/Codes/Standards |   |   |      |      |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Theory                                                                         | -                      | -                         |   |   |      |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                | Co-requisite Course(s) |                           |   |   |      |      |
| Cloud Computing, Computer Networks                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                | Nil                    |                           |   |   |      |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To Understand the architecture and security challenges of cloud computing.     |                        |                           |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Understand cryptographic mechanisms used in cloud security.                    |                        |                           |   |   |      |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Apply secure cloud design principles and data protection techniques.           |                        |                           |   |   |      |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Apply identity management and access control mechanisms in cloud environments. |                        |                           |   |   |      |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Apply monitoring, auditing, and compliance practices for secure cloud systems. |                        |                           |   |   |      |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                |                        |                           |   |   |      |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                |                        |                           |   |   |      |      |
| C504.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Explain cloud security concepts and cryptographic mechanisms                   |                        |                           |   |   | [U]  |      |
| C504.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Describe cloud security architecture and protection mechanisms                 |                        |                           |   |   | [U]  |      |
| C504.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply identity management and access control techniques in cloud               |                        |                           |   |   | [AP] |      |
| C504.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply cloud security models and design patterns for secure deployment          |                        |                           |   |   | [AP] |      |
| C504.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply monitoring, auditing and management mechanisms in cloud security         |                        |                           |   |   | [AP] |      |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                |                        |                           |   |   |      |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | FUNDAMENTALS OF CLOUD SECURITY                                                 |                        |                           |   |   | C01  | 9Hrs |
| Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Nonrepudiation, Access Control - Fundamentals of Cryptography - Symmetric Cryptography - Public Key Cryptography - Hash Functions - Authentication Mechanisms - Digital Signatures - Role of Cryptography in Cloud Security.                                                                                                                                                   |                                                                                |                        |                           |   |   |      |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | CLOUD SECURITY DESIGN AND ARCHITECTURE                                         |                        |                           |   |   | C02  | 9Hrs |
| Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key.                         |                                                                                |                        |                           |   |   |      |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | IDENTITY MANAGEMENT AND ACCESS CONTROL                                         |                        |                           |   |   | C03  | 9Hrs |
| Identity and Access Management in Cloud - Access Control Models - Role-Based Access Control (RBAC) - Attribute-Based Access Control (ABAC) - Authentication Mechanisms - Multi-Factor Authentication - Single Sign-On (SSO) - Identity Federation - OAuth and SAML - Identity Providers and Service Consumers - Storage Access Control - Network Access Control - Operating System Hardening - Secure Boot and Measured Boot - Intrusion Detection and Prevention Systems. |                                                                                |                        |                           |   |   |      |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | CLOUD SECURITY MODELS AND DESIGN PATTERNS                                      |                        |                           |   |   | C04  | 9Hrs |
| Introduction to Security Design Patterns - Cloud Security Reference Architecture - Cloud Resource Access Control - Secure Cloud Interfaces - Cloud Bursting - Geo-tagging - Secure On-Premise Internet Access - Secure External Cloud - Secure API Gateways - Microservices Security - Container Security - DevSecOps in Cloud - Zero Trust Security Model.                                                                                                                |                                                                                |                        |                           |   |   |      |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | MONITORING, AUDITING AND MANAGEMENT                                            |                        |                           |   |   | C05  | 9Hrs |
| Introduction to Security Design Patterns - Cloud Security Reference Architecture - Cloud Resource Access Control - Secure Cloud Interfaces - Cloud Bursting - Geo-tagging - Secure On-Premise Internet Access - Secure External Cloud - Secure API Gateways - Microservices Security - Container Security - DevSecOps in Cloud - Zero Trust Security Model.                                                                                                                |                                                                                |                        |                           |   |   |      |      |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                |                        |                           |   |   | 45   |      |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                |                        |                           |   |   |      |      |

|                         |                                                                                                                                                                                                           |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                       | Tim Mather, Subra Kumaraswamy, Shahed Latif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, 1st Edition O'Reilly Media 2009, ISBN: 978-0596802769.                        |
| 2                       | Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, 1st Edition, Wiley Publishing, 2010, ISBN: 978-0470589878.                                          |
| 3                       | Vic (J.R.) Winkler, Securing the Cloud: Cloud Computer Security Techniques and Tactics, 1st Edition, Elsevier / Syngress, 2011, ISBN: 978-1597495929.                                                     |
| <b>Reference Books:</b> |                                                                                                                                                                                                           |
| 1                       | Thomas Erl, Cloud Computing: Concepts, Technology and Architecture, 1st Edition, Prentice Hall / Pearson Education, 2013, ISBN: 978-0133387520.                                                           |
| 2                       | Rajkumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing: Principles and Paradigms, 1st Edition, Wiley, 2011, ISBN: 978-0470887998.                                                              |
| <b>Web References:</b>  |                                                                                                                                                                                                           |
| 1                       | National Institute of Standards and Technology, NIST SP 800-145: The NIST Definition of Cloud Computing, NIST Publications, 2011, Available at: <a href="https://www.nist.gov">https://www.nist.gov</a> . |

**Assessment based on Continuous and End Semester Examination**

| BLOOM'S TAXONOMY LEVEL   | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|--------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
|                          | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                 |                       |                |                      | 10         | 10         | 60                       |
| Understand               | 80                    | 20             | 20                   |            |            |                          |
| Apply                    | 20                    | 80             | 80                   |            |            |                          |
| Analyze                  |                       |                |                      |            |            |                          |
| Evaluate                 |                       |                |                      |            |            |                          |
| Create                   |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C504.1      | 3    | 2    | 1    | -    | 2    | -    | -    | -    | -    | 2     | 3     | 2     | 2     |
| C504.2      | 2    | 3    | 1    | 2    | 2    | -    | -    | -    | -    | 2     | 3     | 2     | 3     |
| C504.3      | 2    | 3    | 2    | 2    | 3    | -    | -    | -    | -    | 2     | 3     | 2     | 3     |
| C504.4      | 2    | 2    | 2    | 3    | 3    | -    | -    | -    | -    | 2     | 3     | 1     | 3     |
| C504.5      | 3    | 2    | 2    | 2    | 3    | -    | -    | -    | -    | 3     | 3     | 2     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                      | Course Name                                                                                                                    | Category               | Hours/Week                |   |   | C        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----------|
|                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                |                        | L                         | T | P |          |
| 24CS505                                                                                                                                                                                                                                                                                                                          | STORAGE TECHNOLOGY                                                                                                             | PE                     | 3                         | 0 | 0 | 3        |
| Regulation                                                                                                                                                                                                                                                                                                                       | Nature of the Course                                                                                                           | Semester               | Data Book/Codes/Standards |   |   |          |
| 2024                                                                                                                                                                                                                                                                                                                             | THEORY                                                                                                                         | 5                      | -                         |   |   |          |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                          |                                                                                                                                | Co-requisite Course(s) |                           |   |   |          |
| Database Design and Management Systems                                                                                                                                                                                                                                                                                           |                                                                                                                                | Big Data Analytics     |                           |   |   |          |
| Course Objectives                                                                                                                                                                                                                                                                                                                |                                                                                                                                |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                | To understand the physical and logical components of storage.                                                                  |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                | To implement RAID and the intelligent storage systems                                                                          |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                | To set up SAN, NAS, and virtualized storage environments.                                                                      |                        |                           |   |   |          |
| 4                                                                                                                                                                                                                                                                                                                                | To demonstrate disaster recovery and backup strategies.                                                                        |                        |                           |   |   |          |
| 5                                                                                                                                                                                                                                                                                                                                | To examine security measures with the implementation of storage security mechanisms                                            |                        |                           |   |   |          |
| Course Outcomes                                                                                                                                                                                                                                                                                                                  |                                                                                                                                |                        |                           |   |   |          |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                          |                                                                                                                                |                        |                           |   |   |          |
| C505.1                                                                                                                                                                                                                                                                                                                           | Understand the information storage devices, computing platforms and data center environments                                   |                        |                           |   |   | [U]      |
| C505.2                                                                                                                                                                                                                                                                                                                           | Implementation of intelligent storage systems and RAID                                                                         |                        |                           |   |   | [AP]     |
| C505.3                                                                                                                                                                                                                                                                                                                           | Examine Storage Networking Technologies and Virtualization                                                                     |                        |                           |   |   | [AN]     |
| C505.4                                                                                                                                                                                                                                                                                                                           | Demonstrate virtualized storage environments                                                                                   |                        |                           |   |   | [AP]     |
| C505.5                                                                                                                                                                                                                                                                                                                           | Examine security measures with the implementation of storage security mechanisms                                               |                        |                           |   |   | [AN]     |
| Course Contents                                                                                                                                                                                                                                                                                                                  |                                                                                                                                |                        |                           |   |   |          |
| Unit-1                                                                                                                                                                                                                                                                                                                           | Introduction to Information Storage                                                                                            |                        |                           |   |   | C01 9Hrs |
| Digital data types (structured/unstructured), data center components, Information Lifecycle Management (ILM)-Evolution of Computing Platforms: Third Platform Technologies: Cloud computing, Big Data analytics, Social networking, and Mobile computing - Data Center Environment: Core elements, software-defined data center. |                                                                                                                                |                        |                           |   |   |          |
| Unit-2                                                                                                                                                                                                                                                                                                                           | Intelligent Storage Systems and RAID                                                                                           |                        |                           |   |   | C02 9Hrs |
| Intelligent Storage Systems: Components, architecture, and performance-RAID: RAID implementations, RAID array components, and RAID performance-Storage Types: File-based, Object-based, and Unified storage.                                                                                                                     |                                                                                                                                |                        |                           |   |   |          |
| Unit-3                                                                                                                                                                                                                                                                                                                           | Storage Networking Technologies and Virtualization                                                                             |                        |                           |   |   | C03 9Hrs |
| Storage Networking: Fibre Channel SAN (FC SAN) components, topologies, and architecture - Networking Protocols: iSCSI, FCIP, and FCoE (Fibre Channel over Ethernet) - Storage Virtualization: Block-level and file-level virtualization, software-defined storage.                                                               |                                                                                                                                |                        |                           |   |   |          |
| Unit-4                                                                                                                                                                                                                                                                                                                           | Backup, Replication, and Disaster Recovery                                                                                     |                        |                           |   |   | C04 9Hrs |
| Backup and Recovery: Information availability, business continuity, backup methods, and recovery techniques - Replication Technologies: Local and remote replication, storage-based, compute-based, and network-based replication - Disaster Recovery: Disaster recovery as a service (DRaaS).                                   |                                                                                                                                |                        |                           |   |   |          |
| Unit-5                                                                                                                                                                                                                                                                                                                           | Securing Storage Infrastructure                                                                                                |                        |                           |   |   | C05 9Hrs |
| Storage Security: Security framework, threats, and risk management - Security Measures: Security in FC SAN, iSCSI, and NAS environments - Management: Monitoring and managing storage infrastructure.                                                                                                                            |                                                                                                                                |                        |                           |   |   |          |
| Total Hours                                                                                                                                                                                                                                                                                                                      |                                                                                                                                |                        |                           |   |   | 45       |
| Textbooks:                                                                                                                                                                                                                                                                                                                       |                                                                                                                                |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                | Susanta Dutta "Computer storage fundamentals ", 2nd Edition, BPB Publications, 2025.                                           |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                | Jiwu Shu "Data Storage Architectures and Technologies", Springer publications, 2024.                                           |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                | Azam Seyedi, "Computer Memory and Data Storage", Intech Open publications , 2024.                                              |                        |                           |   |   |          |
| Reference Books:                                                                                                                                                                                                                                                                                                                 |                                                                                                                                |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                | Sachi Choudhary, "Fundamentals of Storage Technologies", Technical Publications, 2023.                                         |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                | Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw-Hill Education, 2023.                                 |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                | Vaishali Khairnar, "Storage Network Management and Retrieval", Technical Publications, 2019.                                   |                        |                           |   |   |          |
| 4                                                                                                                                                                                                                                                                                                                                | S. P. S. Saini, "Computer Storage Fundamentals: Storage System, Storage Networking, and Host Connectivity", 2nd Edition, 2020. |                        |                           |   |   |          |

**WebReferences:**

|   |                                                                                                                                                           |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <a href="https://spark.apache.org/docs/latest/streaming-programming-guide.html">https://spark.apache.org/docs/latest/streaming-programming-guide.html</a> |
| 2 | <a href="https://spark.apache.org/docs/latest/streaming-kafka-integration.html">https://spark.apache.org/docs/latest/streaming-kafka-integration.html</a> |

**Assessment based on Continuous and End Semester Examination**

| BLOOM'S<br>TAXONOMY<br>LEVEL | CONTINUOUS ASSESSMENT |                   |                         | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
|                              | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                     |                       |                   |                         | 10         | 10         | 60                       |
| Understand                   | 60                    | 20                | 20                      |            |            |                          |
| Apply                        | 40                    | 60                | 40                      |            |            |                          |
| Analyze                      |                       | 20                | 40                      |            |            |                          |
| Evaluate                     |                       |                   |                         |            |            |                          |
| Create                       |                       |                   |                         |            |            |                          |
| <b>Total<br/>(100 Marks)</b> | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C505.1      | 3    | 3    | 2    | 2    | 2    | 2    | -    | -    | -    | 2     | 2     | 2     | 2     |
| C505.2      | 3    | 3    | 2    | 2    | 2    | 3    | -    | -    | -    | 3     | 2     | 3     | 3     |
| C505.3      | 3    | 3    | 2    | 3    | 2    | 2    | -    | -    | -    | 2     | 2     | 3     | 3     |
| C505.4      | 3    | 2    | 3    | 2    | 2    | 2    | -    | -    | -    | 3     | 2     | 3     | 3     |
| C505.5      | 3    | 3    | 3    | 3    | 2    | 2    | -    | -    | -    | 2     | 3     | 3     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                     | Course Name                                                                                                                            | Category               | Hours/Week                |   |   | C        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----------|
|                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                        |                        | L                         | T | P |          |
| 24CS506                                                                                                                                                                                                                                                                                                                                                                         | STREAMPROCESSING                                                                                                                       | PE                     | 3                         | 0 | 0 | 3        |
| Regulation                                                                                                                                                                                                                                                                                                                                                                      | Nature of the Course                                                                                                                   | Semester               | Data Book/Codes/Standards |   |   |          |
| 2024                                                                                                                                                                                                                                                                                                                                                                            | THEORY                                                                                                                                 | -                      | -                         |   |   |          |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                        | Co-requisite Course(s) |                           |   |   |          |
| Database Design and Management Systems                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                        | Big Data Analytics     |                           |   |   |          |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                        |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                                               | To introduce data processing paradigms and modern data systems for real-time concepts                                                  |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                                               | To select appropriate structures for business-oriented real-time data services                                                         |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                                                                               | To understand and identify the architectures for storage systems in distributed systems and stream processing                          |                        |                           |   |   |          |
| 4                                                                                                                                                                                                                                                                                                                                                                               | To design and implement real-time applications using Apache Spark or Kafka                                                             |                        |                           |   |   |          |
| 5                                                                                                                                                                                                                                                                                                                                                                               | To implement Spark structured streaming and design fault tolerance in streaming systems                                                |                        |                           |   |   |          |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                        |                        |                           |   |   |          |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                         |                                                                                                                                        |                        |                           |   |   |          |
| C506.1                                                                                                                                                                                                                                                                                                                                                                          | Summarize data processing paradigms and modern data systems                                                                            |                        |                           |   |   | [U]      |
| C506.2                                                                                                                                                                                                                                                                                                                                                                          | Describe data management strategies and NoSQL data models                                                                              |                        |                           |   |   | [AP]     |
| C506.3                                                                                                                                                                                                                                                                                                                                                                          | identify the architectures for storage systems in distributed systems and stream processing                                            |                        |                           |   |   | [AP]     |
| C506.4                                                                                                                                                                                                                                                                                                                                                                          | Make use of Kafka in event processing systems and design use cases for event driven systems                                            |                        |                           |   |   | [AP]     |
| C506.5                                                                                                                                                                                                                                                                                                                                                                          | Execute real time analytics in streaming applications using Apache Spark                                                               |                        |                           |   |   | [AP]     |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                        |                        |                           |   |   |          |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                          | Data Systems & Processing Models                                                                                                       |                        |                           |   |   | C01 9Hrs |
| Overview of modern data systems and data processing paradigms: batch processing vs stream processing-Characteristics and applications of batch processing -Characteristics and applications of real-time stream processing - differences between batch and stream processing- Use cases and industry applications.                                                              |                                                                                                                                        |                        |                           |   |   |          |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                          | Data Management Strategies and Data Models                                                                                             |                        |                           |   |   | C02 9Hrs |
| Data management in large-scale distributed systems- Data storage strategies and scalability considerations- Overview of NoSQL databases- Types of NoSQL databases: Key-Value Stores- Document Databases- Column-Oriented Databases- Graph Databases Introduction to Graph Data Models- Comparison of relational and NoSQL data models Applications of graph-based data systems. |                                                                                                                                        |                        |                           |   |   |          |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                          | Stream Processing Technologies                                                                                                         |                        |                           |   |   | C03 9Hrs |
| Introduction to real-time data processing frameworks` - Stream processing architecture and workflow Lambda Architecture- Batch layer, Speed layer, Serving layer Kappa Architecture- Concept and benefits- Distributed storage systems in stream processing- Data ingestion and data flow management- Stream processing pipelines.                                              |                                                                                                                                        |                        |                           |   |   |          |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                          | Event Processing with Kafka                                                                                                            |                        |                           |   |   | C04 9Hrs |
| Introduction to Apache Kafka- Kafka architecture and ecosystem-Components of Kafka-Kafka data flow and message handling -Kafka Producer API - Kafka Consumer API -Kafka use cases in event-driven systems.                                                                                                                                                                      |                                                                                                                                        |                        |                           |   |   |          |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                          | Spark Streaming                                                                                                                        |                        |                           |   |   | C05 9Hrs |
| Introduction to Apache Spark and streaming analytics- Overview of Spark Structured Streaming- Micro-batch processing model- Window-based stream processing- Watermarking for late data handling- Fault tolerance in streaming systems- Checkpointing and recovery mechanisms- Real-time analytics applications.                                                                 |                                                                                                                                        |                        |                           |   |   |          |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                        |                        |                           |   |   | 45       |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                        |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                                                                               | Joe Reis, Matt Housley, Reuven Lax, "Fundamentals of Data Engineering: Plan and Build Robust Data Systems" O'Reilly Media, 2022.       |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                                                                               | Fabian Hueske, Vasiliki Kalavri, "Fundamentals of Stream Processing: Application Design, Systems, and Analytics", O'Reilly Media, 2019 |                        |                           |   |   |          |

|   |                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | Martin Kleppmann, "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems", O'Reilly Media, 2017. |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------|

| Reference Books: |                                                                                                                                                                      |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                | Fabian Hueske, Vasiliki Kalavri, "Stream Processing with Apache Flink: Fundamentals, Implementation, and Operation of Streaming Applications", O'Reilly Media, 2019. |
| 2                | Mayank Pandey, "Kafka Streams: Real-Time Stream Processing", Packet Publishing, 2019.                                                                                |
| 3                | Ben Stopford, "Designing Event-Driven Systems: Concepts and Patterns for Streaming Services with Apache Kafka", O'Reilly Media, 2018.                                |
| Web References:  |                                                                                                                                                                      |
| 1                | <a href="https://flink.apache.org/">https://flink.apache.org/</a>                                                                                                    |
| 2                | <a href="https://docs.databricks.com/">https://docs.databricks.com/</a>                                                                                              |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 60                    | 40             | 40                   |            |            |                          |
| Apply                                                       | 40                    | 60             | 60                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C506.1      | 3    | 3    | 2    | 3    | 1    | -    | -    | -    | 2    | 3     | 3     | 2     | 3     |
| C506.2      | 2    | 2    | 2    | 3    | 3    | -    | -    | -    | 2    | 2     | 3     | 3     | 3     |
| C506.3      | 3    | 2    | 2    | 3    | 3    | -    | -    | -    | 2    | 2     | 3     | 3     | 2     |
| C506.4      | 2    | 3    | 3    | 3    | 3    | -    | -    | -    | 2    | 2     | 2     | 3     | 2     |
| C506.5      | 3    | 3    | 3    | 2    | 2    | -    | -    | -    | 2    | 3     | 3     | 3     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

**VERTICALIV  
EMERGINGTECHNOLOGIES**

| Course Code                                                                                                                                                                                                                                                                                                                                                                          | Course Name                                                                                                                       | Category               | Hours/Week                |   |             | C  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-------------|----|
|                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                   |                        | L                         | T | P           |    |
| 24AD508                                                                                                                                                                                                                                                                                                                                                                              | AUGMENTED REALITY/VIRTUAL REALITY                                                                                                 | PE                     | 3                         | 0 | 0           | 3  |
| Regulation                                                                                                                                                                                                                                                                                                                                                                           | Nature of the Course                                                                                                              | Semester               | Data Book/Codes/Standards |   |             |    |
| 2024                                                                                                                                                                                                                                                                                                                                                                                 | THEORY                                                                                                                            | -                      | -                         |   |             |    |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                   | Co-requisite Course(s) |                           |   |             |    |
|                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                   |                        |                           |   |             |    |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                   |                        |                           |   |             |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                    | Explain fundamentals of Virtual Reality Systems                                                                                   |                        |                           |   |             |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                    | Summarize the Fundamentals of VR and hardware and software of the Virtual Reality                                                 |                        |                           |   |             |    |
| 3                                                                                                                                                                                                                                                                                                                                                                                    | To learn about the graphical processing units and their architectures                                                             |                        |                           |   |             |    |
| 4                                                                                                                                                                                                                                                                                                                                                                                    | To gain knowledge about AR/VR application development.                                                                            |                        |                           |   |             |    |
| 5                                                                                                                                                                                                                                                                                                                                                                                    | Understand the usage of Augmented Reality                                                                                         |                        |                           |   |             |    |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                   |                        |                           |   |             |    |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                              |                                                                                                                                   |                        |                           |   |             |    |
| C508.1                                                                                                                                                                                                                                                                                                                                                                               | Understand the basic concepts of Virtual Reality Fundamentals                                                                     |                        |                           |   |             | U  |
| C508.2                                                                                                                                                                                                                                                                                                                                                                               | Differentiate the O/P devices of VR                                                                                               |                        |                           |   |             | U  |
| C508.3                                                                                                                                                                                                                                                                                                                                                                               | Discuss various modeling techniques of VR                                                                                         |                        |                           |   |             | AP |
| C508.4                                                                                                                                                                                                                                                                                                                                                                               | Predict various Applications of VR                                                                                                |                        |                           |   |             | AP |
| C508.5                                                                                                                                                                                                                                                                                                                                                                               | Illustrate working principles of AR                                                                                               |                        |                           |   |             | AP |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                   |                        |                           |   |             |    |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                               | INTRODUCTION                                                                                                                      |                        |                           |   | C01         | 9  |
| Introduction: The three I's of virtual reality, commercial VR technology and the five classic components of a VR system.<br>Input Devices: Three-dimensional position trackers, navigation and manipulation.                                                                                                                                                                         |                                                                                                                                   |                        |                           |   |             |    |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                               | OUTPUT DEVICES                                                                                                                    |                        |                           |   | C02         | 9  |
| Gesture Interfaces - The Pinch Glove, The 5DT Data Glove, The Didjiglove, The CyberGlove - Gesture Interfaces - Types of Gesture Input Devices<br>Output Devices - Graphics Display - Human Visual System - Personal Graphics Displays - Large - Volume Displays - Sound Displays - Human Auditory System.                                                                           |                                                                                                                                   |                        |                           |   |             |    |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                               | MODELING AND VR PROGRAMMING                                                                                                       |                        |                           |   | C03         | 9  |
| Modeling: Geometric modelling - Kinematics Modeling - Physical Modeling - behavior modelling - model management. VR Programming - Toolkits and Scene Graphs - World Tool Kit - Java 3D - Comparison of World Tool Kit and Java 3D                                                                                                                                                    |                                                                                                                                   |                        |                           |   |             |    |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                               | APPLICATIONS                                                                                                                      |                        |                           |   | C04         | 9  |
| Human Factors in VR - Methodology and Terminology - VR Health and Safety Issues - VR and Society - Medical Applications of VR - Education, Arts and Entertainment - Military VR Applications - Emerging Applications of VR - VR Applications in Manufacturing - Applications of VR in Robotics - Information Visualization - VR in Business - VR in Entertainment - VR in Education. |                                                                                                                                   |                        |                           |   |             |    |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                               | AUGMENTED REALITY                                                                                                                 |                        |                           |   | C05         | 9  |
| Introduction to Augmented Reality - Augmented Reality Concepts - Working principles of Augmented Reality. Visualization techniques for augmented reality. Computer vision for AR - Interaction - Modelling and Annotation - Navigation - Wearable devices.                                                                                                                           |                                                                                                                                   |                        |                           |   |             |    |
|                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                   |                        |                           |   | Total Hours | 45 |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                   |                        |                           |   |             |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                    | Samuel Greengard, Steven Jay Cohen, "Virtual Reality", Gilden Media, First Edition, 2019                                          |                        |                           |   |             |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                    | Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018 |                        |                           |   |             |    |

|                         |                                                                                                                                                                                                                      |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3                       | Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016                                                                                                                |
| <b>Reference Books:</b> |                                                                                                                                                                                                                      |
| 1                       | John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.                                                                                                                                                |
| 2                       | William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann, 2003                                                                                            |
| 3                       | Gregory C. Burdea & Philippe Coiffet, "Virtual Reality Technology", Second Edition, John Wiley & Sons, 2006                                                                                                          |
| 4                       | Allan Fowler – AR Game Development II, 1st Edition, Apress Publications, 2018, ISBN 978-1484236178                                                                                                                   |
| <b>Web References:</b>  |                                                                                                                                                                                                                      |
| 1                       | <a href="https://techooid.com/input-devices-vr">https://techooid.com/input-devices-vr</a><br><a href="https://www.marxentlabs.com/what-is-virtual-reality/">https://www.marxentlabs.com/what-is-virtual-reality/</a> |
| 2                       | <a href="https://www.techtarget.com/whatis/definition/virtual-reality">https://www.techtarget.com/whatis/definition/virtual-reality</a>                                                                              |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 100%                  | 20%            | 40%                  |            |            |                          |
| Apply                                                       |                       | 80%            | 60%                  |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/POs | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P010 | P011 | PS01 | PS02 | PS03 |
|---------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| C508.1  | 3   | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | 1    | 2    | 2    | 2    |
| C508.2  | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | 2    | 3    | 2    | 2    |
| C508.3  | 3   | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | 1    | 3    | 2    | 2    |
| C508.4  | 3   | 3   | 3   | 2   | -   | -   | -   | -   | -   | -    | 2    | 3    | 2    | 2    |
| C508.5  | 3   | 3   | 3   | 3   | -   | -   | -   | -   | -   | -    | 3    | 3    | 3    | 3    |

1-Low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                             | Course Name                                                                                                                           | Category               | Hours/Week                |   |   | C   |   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|-----|---|
|                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                       |                        | L                         | T | P |     |   |
| 24AD510                                                                                                                                                                                                                                                                                                                                                                                                 | CYBERSECURITY                                                                                                                         | PE                     | 3                         | 0 | 0 | 3   |   |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                              | Nature of the Course                                                                                                                  | Semester               | Data Book/Codes/Standards |   |   |     |   |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                    | THEORY                                                                                                                                |                        | -                         |   |   |     |   |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                       | Co-requisite Course(s) |                           |   |   |     |   |
| Computer Network, Network Security                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                       | -                      |                           |   |   |     |   |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                       |                        |                           |   |   |     |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                       | To understand the fundamental concepts of cybersecurity, security goals, threat landscape and cyber laws including the Indian IT Act. |                        |                           |   |   |     |   |
| 2                                                                                                                                                                                                                                                                                                                                                                                                       | To analyze various cyber threats, malware types, social engineering techniques and web/network attacks.                               |                        |                           |   |   |     |   |
| 3                                                                                                                                                                                                                                                                                                                                                                                                       | To perform reconnaissance, scanning and vulnerability assessment using standard security tools.                                       |                        |                           |   |   |     |   |
| 4                                                                                                                                                                                                                                                                                                                                                                                                       | To understand intrusion detection systems, monitoring techniques and security event management concepts.                              |                        |                           |   |   |     |   |
| 5                                                                                                                                                                                                                                                                                                                                                                                                       | To configure and implement firewall technologies and intrusion prevention mechanisms in controlled environments.                      |                        |                           |   |   |     |   |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                       |                        |                           |   |   |     |   |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                       |                        |                           |   |   |     |   |
| C510.1                                                                                                                                                                                                                                                                                                                                                                                                  | Explain the fundamental principles of cybersecurity, security goals and cyber laws.                                                   |                        |                           |   |   | U   |   |
| C510.2                                                                                                                                                                                                                                                                                                                                                                                                  | Examine various cyber threats, vulnerabilities and attack mechanisms in computing systems.                                            |                        |                           |   |   | AP  |   |
| C510.3                                                                                                                                                                                                                                                                                                                                                                                                  | Apply various tools to perform information gathering.                                                                                 |                        |                           |   |   | AP  |   |
| C510.4                                                                                                                                                                                                                                                                                                                                                                                                  | Use intrusion techniques to detect intrusion                                                                                          |                        |                           |   |   | AP  |   |
| C510.5                                                                                                                                                                                                                                                                                                                                                                                                  | Demonstrate intrusion prevention techniques to prevent intrusion                                                                      |                        |                           |   |   | AP  |   |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                       |                        |                           |   |   |     |   |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                  | UNIT-I- FOUNDATIONS OF CYBERSECURITY                                                                                                  |                        |                           |   |   | C01 | 9 |
| Introduction to Cyber Security – Evolution of Internet and its Impact – Security Goals (Confidentiality, Integrity, Availability) – Need for Cyber Security – Threat Landscape – Cyber Crime: History and Classification – Cyber criminals and Motivations – Global Perspective on Cyber Crimes – Cyber Laws – The Indian IT Act – Data Privacy Act- Cybercrime Investigation and Punishment.           |                                                                                                                                       |                        |                           |   |   |     |   |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                  | CYBER THREATS AND DEFENSE MECHANISMS                                                                                                  |                        |                           |   |   | C02 | 9 |
| Overview of OWASP – Security Breaches and Case Studies – Threats and Vulnerabilities – Types of Malicious Attacks – Malware (Virus, Worm, Trojan, Ransomware, Spyware) – Social Engineering Techniques – Data poisoning Attacks – adversarial attacks – Wireless Network Attacks – Web Application Attacks – Common Attack Vectors – Attack Tools and Basic Countermeasures – Security of AI Systems.   |                                                                                                                                       |                        |                           |   |   |     |   |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                  | RECONNAISSANCE AND VULNERABILITY SCANNING                                                                                             |                        |                           |   |   | C03 | 9 |
| Foot printing and Information Gathering – Harvester – Whois – Netcraft – Host – DNS Information Extraction – Email Server Information Extraction – Scanning Concepts – Port Scanning and Network Scanning – Vulnerability Scanning – Scanning Methodology – Ping Sweep Techniques – Nmap Command Switches – SYN, Stealth, XMAS, NULL, IDLE, FIN Scans – Banner Grabbing – OS Fingerprinting Techniques. |                                                                                                                                       |                        |                           |   |   |     |   |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                  | INTRUSION DETECTION AND SECURITY MONITORING                                                                                           |                        |                           |   |   | C04 | 9 |
| Host-Based Intrusion Detection Systems – Network-Based Intrusion Detection Systems – Distributed and Hybrid IDS – Intrusion Detection Exchange Format – Honeypots – Snort Architecture and Configuration – Basic Security Event Monitoring Concepts                                                                                                                                                     |                                                                                                                                       |                        |                           |   |   |     |   |

|                                                                                                                                                                                                                                                                                |                                                                                                                 |     |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----|----|
| Unit-5                                                                                                                                                                                                                                                                         | INTRUSION PREVENTION AND FIREWALL TECHNOLOGIES                                                                  | C05 | 9  |
| Firewalls and Intrusion Prevention Systems – Need for Firewalls – Firewall Characteristics – Access Control Policies – Types of Firewalls – Firewall Placement and Configurations – Next Generation Firewalls – Intrusion Prevention Systems – Unified Threat Management (UTM) |                                                                                                                 |     |    |
| Total Hours                                                                                                                                                                                                                                                                    |                                                                                                                 |     | 45 |
| Textbooks:                                                                                                                                                                                                                                                                     |                                                                                                                 |     |    |
| 1                                                                                                                                                                                                                                                                              | Anand Shinde, <i>Introduction to Cyber Security: Guide to the World of Cyber Security</i> , Notion Press, 2021. |     |    |
| 2                                                                                                                                                                                                                                                                              | Nina Godbole and Sunit Belapure, <i>Cyber Security</i> , Wiley India.                                           |     |    |
| 3                                                                                                                                                                                                                                                                              | Charles P. Pfleeger & Shari Lawrence Pfleeger, <i>Security in Computing</i> , Pearson                           |     |    |
| Reference Books:                                                                                                                                                                                                                                                               |                                                                                                                 |     |    |
| 1                                                                                                                                                                                                                                                                              | William Stallings, <i>Cryptography and Network Security</i> , Pearson.                                          |     |    |
| 2                                                                                                                                                                                                                                                                              | Michael E. Whitman & Herbert J. Mattord, <i>Principles of Information Security</i> , Cengage.                   |     |    |
| 3                                                                                                                                                                                                                                                                              | Ric Messier, <i>CEH v11 Study Guide</i> , Wiley.                                                                |     |    |
| 4                                                                                                                                                                                                                                                                              | The Information Technology Act, 2000 (Amended 2008), Government of India                                        |     |    |
| Web References:                                                                                                                                                                                                                                                                |                                                                                                                 |     |    |
| 1                                                                                                                                                                                                                                                                              | <a href="https://owasp.org/www-project-top-ten/">https://owasp.org/www-project-top-ten/</a>                     |     |    |

**Assessment based on Continuous and End Semester Examination**

| BLOOM'S TAXONOMY LEVEL   | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|--------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
|                          | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                 |                       |                |                      | 10         | 10         | 60                       |
| Understand               | 80                    |                | 20                   |            |            |                          |
| Apply                    | 20                    | 100            | 80                   |            |            |                          |
| Analyze                  |                       |                |                      |            |            |                          |
| Evaluate                 |                       |                |                      |            |            |                          |
| Create                   |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| C0s/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C510.1      | 3    | 2    | 1    | 1    | -    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 2     |
| C510.2      | 2    | 3    | 2    | 2    | -    | -    | -    | -    | -    | -     | 1     | 3     | 2     | 1     |
| C510.3      | 2    | 3    | 2    | 3    | -    | -    | -    | -    | -    | -     | 1     | 3     | 2     | 2     |
| C510.4      | 2    | 3    | 2    | 3    | -    | -    | -    | -    | -    | -     | 1     | 3     | 2     | 2     |
| C510.5      | 2    | 2    | 3    | 2    | -    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 1     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                         | Course Name                                                                                                                                                                | Category                          | Hours/Week                |   |   | C    |   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|---------------------------|---|---|------|---|
|                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                            |                                   | L                         | T | P |      |   |
| 25AM501                                                                                                                                                                                                                                                                                                                                                                                                                             | Cryptocurrency and Blockchain Technology                                                                                                                                   | PE                                | 3                         | 0 | 0 | 3    |   |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                          | Nature of the Course                                                                                                                                                       | Semester                          | Data Book/Codes/Standards |   |   |      |   |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                                | Theory                                                                                                                                                                     |                                   | Nil                       |   |   |      |   |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                            | Co-requisite Course(s)            |                           |   |   |      |   |
| Computer Networks, Data Structures and Algorithms                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                            | Cryptography and Network Security |                           |   |   |      |   |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                            |                                   |                           |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                   | To understand the basics of Blockchain                                                                                                                                     |                                   |                           |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                   | To learn Different protocols and consensus algorithms in Blockchain                                                                                                        |                                   |                           |   |   |      |   |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                   | To learn the Blockchain implementation frameworks                                                                                                                          |                                   |                           |   |   |      |   |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                   | To provide knowledge of cryptographic techniques used for securing blockchain systems.                                                                                     |                                   |                           |   |   |      |   |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                   | To provide an understanding of blockchain applications in emerging technologies.                                                                                           |                                   |                           |   |   |      |   |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                            |                                   |                           |   |   |      |   |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                            |                                   |                           |   |   |      |   |
| C501.1                                                                                                                                                                                                                                                                                                                                                                                                                              | Understand the concepts of Bitcoin, mining, wallets, and token ecosystems                                                                                                  |                                   |                           |   |   | [U]  |   |
| C501.2                                                                                                                                                                                                                                                                                                                                                                                                                              | Describe the working principles of Bitcoin and cryptocurrencies including transaction processing, mining, scripting, wallets, and security mechanisms.                     |                                   |                           |   |   | [U]  |   |
| C501.3                                                                                                                                                                                                                                                                                                                                                                                                                              | Understand blockchain consensus mechanisms such as Proof of Work (PoW), Proof of Stake (PoS), and Proof of Burn (PoB) in the cryptocurrency ecosystem.                     |                                   |                           |   |   | [U]  |   |
| C501.4                                                                                                                                                                                                                                                                                                                                                                                                                              | Apply cryptographic techniques such as public-private keys, digital signatures, hash functions, and Elliptic Curve Cryptography to enhance security in blockchain systems. |                                   |                           |   |   | [AP] |   |
| C501.5                                                                                                                                                                                                                                                                                                                                                                                                                              | Apply blockchain concepts to emerging applications including NFTs, Central Bank Digital Currencies (CBDCs), and Internet of Things (IoT) based systems.                    |                                   |                           |   |   | [AP] |   |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                            |                                   |                           |   |   |      |   |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                              | INTRODUCTION TO CRYPTOCURRENCIES                                                                                                                                           |                                   |                           |   |   | C01  | 9 |
| Definition and characteristics-Digital currency vs. traditional currency-Decentralization and distributed ledger technology-Origin of cryptocurrencies-Historical challenges and successes-Components of a blockchain-Overview of Bitcoin-Mining and the creation of new coins-Wallets and transactions on the Bitcoin network-alternative cryptocurrencies (Altcoins)-Token creation and use cases-Initial Coin Offerings (ICOs) . |                                                                                                                                                                            |                                   |                           |   |   |      |   |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                              | BITCOIN AND CRYPTOCURRENCY                                                                                                                                                 |                                   |                           |   |   | C02  | 9 |
| A basic cryptocurrency, Creation of coins, Payments and double spending, FORTH -the precursor for Bitcoin scripting, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay-Bitcoin Wallets and Key Management-Bitcoin Consensus Mechanism-Bitcoin Security and Attacks.                                                                                             |                                                                                                                                                                            |                                   |                           |   |   |      |   |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                              | BITCOIN CONSENSUS                                                                                                                                                          |                                   |                           |   |   | C03  | 9 |
| Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW, Bitcoin PoW, Attack on PoW, monopoly problem-Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool- Permissioned model and use cases- Litecoin- Namecoin- Peercoin- Cryptocurrency ecosystem                                                                                                                                  |                                                                                                                                                                            |                                   |                           |   |   |      |   |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                              | BLOCKCHAIN SECURITY                                                                                                                                                        |                                   |                           |   |   | C04  | 9 |
| Cryptographic Security in Blockchain: Public and private keys, digital signatures, cryptographic hash functions and their properties, key management and secure practices, use of hash functions in Blockchain security, Diffie-Hellman key exchange, Elliptic Curve Cryptography (ECC), and quantum-resistant cryptographic algorithms.                                                                                            |                                                                                                                                                                            |                                   |                           |   |   |      |   |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                              | EMERGING TRENDS AND FUTURE DEVELOPMENTS                                                                                                                                    |                                   |                           |   |   | C05  | 9 |
| Introduction to NFTs-ERC-721 and other token standards-Applications beyond digital art and collectibles- Overview of CBDCs-The role of governments and central banks in digital currencies-Impact on the traditional financial system-Internet of Things (IoT) and blockchain applications-Future trends in the integration of emerging technologies with blockchain.                                                               |                                                                                                                                                                            |                                   |                           |   |   |      |   |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                            |                                   |                           |   |   | 45   |   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                            |                                   |                           |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                   | Arvind Narayanan et al., Bitcoin and Cryptocurrency Technologies, Princeton University Press, 2016.                                                                        |                                   |                           |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                   | Andreas M. Antonopoulos, Mastering Bitcoin, O'Reilly Media, 2nd Edition, 2017.                                                                                             |                                   |                           |   |   |      |   |
| Reference Books:                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                            |                                   |                           |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                   | Imran Bashir, Mastering Blockchain, Packt Publishing, 3rd Edition, 2020.                                                                                                   |                                   |                           |   |   |      |   |



|                        |                                                                                                                                                    |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 2                      | Daniel Drescher, Blockchain Basics, Apress, 2017.                                                                                                  |
| 3                      | Don Tapscott and Alex Tapscott, Blockchain Revolution, Penguin, 2016.                                                                              |
| <b>Web References:</b> |                                                                                                                                                    |
| 1                      | Bitcoin and Cryptocurrency Technologies – <a href="https://bitcoinbook.cs.princeton.edu">https://bitcoinbook.cs.princeton.edu</a>                  |
| 2                      | Ethereum Foundation Documentation – <a href="https://ethereum.org/en/developers/docs/">https://ethereum.org/en/developers/docs/</a>                |
| 3                      | Mastering Bitcoin by Andreas M. Antonopoulos – <a href="https://github.com/bitcoinbook/bitcoinbook">https://github.com/bitcoinbook/bitcoinbook</a> |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 100%                  | 60%            | 60%                  |            |            |                          |
| Apply                                                       |                       | 40%            | 40%                  |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/ POs | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P010 | P011 | PS01 | PS02 |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C501.1   | 3   | 2   |     |     | 1   |     |     |     |     |      | 1    | 2    | 1    |
| C501.2   | 3   | 2   |     |     | 3   |     |     |     |     |      | 1    | 2    | 2    |
| C501.3   | 2   | 3   | 1   |     | 2   |     |     |     |     |      | 1    | 3    | 2    |
| C501.4   | 2   | 3   | 3   | 1   | 3   |     |     |     |     |      | 1    | 2    | 3    |
| C501.5   | 1   | 2   | 3   | 2   | 2   |     |     |     |     |      | 1    | 3    | 3    |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                     | CourseName                                                                                                                            | Category              | Hours/Week               |   |     | C     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|-----|-------|
|                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                       |                       | L                        | T | P   |       |
| 24AM502                                                                                                                                                                                                                                                                                                                                                         | VIDEOCREATION ANDEDITING                                                                                                              | PE                    | 3                        | 0 | 0   | 3     |
| Regulation                                                                                                                                                                                                                                                                                                                                                      | NatureoftheCourse                                                                                                                     | Semester              | DataBook/Codes/Standards |   |     |       |
| R24                                                                                                                                                                                                                                                                                                                                                             | THEORY                                                                                                                                | -                     | -                        |   |     |       |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                       | Co-requisiteCourse(s) |                          |   |     |       |
| --                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                       | -                     |                          |   |     |       |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                       |                       |                          |   |     |       |
| 1                                                                                                                                                                                                                                                                                                                                                               | To understand the fundamentals and evolution of digital video and editing                                                             |                       |                          |   |     |       |
| 2                                                                                                                                                                                                                                                                                                                                                               | To develop storytelling skills using modern editing techniques                                                                        |                       |                          |   |     |       |
| 3                                                                                                                                                                                                                                                                                                                                                               | To capture, edit, and produce professional-quality video and audio                                                                    |                       |                          |   |     |       |
| 4                                                                                                                                                                                                                                                                                                                                                               | To work with industry-standard non-linear editing(NLE) tools                                                                          |                       |                          |   |     |       |
| 5                                                                                                                                                                                                                                                                                                                                                               | To apply emerging technologies in video production and post-production                                                                |                       |                          |   |     |       |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                       |                       |                          |   |     |       |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                                                                                  |                                                                                                                                       |                       |                          |   |     |       |
| C502.1                                                                                                                                                                                                                                                                                                                                                          | Apply the fundamentals and ethical principles of digital video editing in creatingvideo content.                                      |                       |                          |   |     | [AP]  |
| C502.2                                                                                                                                                                                                                                                                                                                                                          | Apply storytelling techniques to create engaging video narratives                                                                     |                       |                          |   |     | [AP]  |
| C502.3                                                                                                                                                                                                                                                                                                                                                          | Apply digital tools and editing techniques to capture and produce audio-visualcontent.                                                |                       |                          |   |     | [AP]  |
| C502.4                                                                                                                                                                                                                                                                                                                                                          | Apply non-linear editing workflows using industry-standard software                                                                   |                       |                          |   |     | [AP]  |
| C502.5                                                                                                                                                                                                                                                                                                                                                          | Analyze and apply emerging technologies in video creation and post-production                                                         |                       |                          |   |     | [AN]  |
| CourseContents                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                       |                       |                          |   |     |       |
| Unit-1                                                                                                                                                                                                                                                                                                                                                          | FUNDAMENTALSOFDIGITALVIDEOANDEDITING                                                                                                  |                       |                          |   | C01 | 9Hrs  |
| Evolution of filmmaking – Transition from linear to non-linear editing – Digital video concepts – Frame rates,aspect ratios, codecs, containers – Economy of expression – Ethics of editing – Risks associated with alteringreality through editing – Introduction to contemporary video workflows – Overview ofdigital cinema and online video platforms.      |                                                                                                                                       |                       |                          |   |     |       |
| Unit-2                                                                                                                                                                                                                                                                                                                                                          | STORYTELLINGANDEDITINGTECHNIQUES                                                                                                      |                       |                          |   | C02 | 9Hrs  |
| Principles ofvisual storytelling – Narrative structures for digital media – Editing styles:jump cuts, match cuts,L-cuts,J-cuts, cutaways, dissolves, splitedits – Rhythmandpacing – Continuityediting – Storytellingforshort-form,socialmedia,andwebvideos–Managingresolutions(HD,4K,8K)– Mediamanagementandproxyworkflows.                                     |                                                                                                                                       |                       |                          |   |     |       |
| Unit-3                                                                                                                                                                                                                                                                                                                                                          | AUDIOANDVIDEOACQUISITION&POST-PRODUCTION                                                                                              |                       |                          |   | C03 | 9Hrs  |
| Capturing digital and analog video – Camera basics – Mobile filmmaking techniques – Importing audio andvideo – Syncing audio – Basic sound design – Voice-over recording – Exporting and rendering formats– Delivery for broadcast, web, and streaming platforms – Archiving and backup strategies.                                                             |                                                                                                                                       |                       |                          |   |     |       |
| Unit-4                                                                                                                                                                                                                                                                                                                                                          | NON-LINEAREDITINGTOOLSANDWORKFLOWS                                                                                                    |                       |                          |   | C04 | 9Hrs  |
| Workingwith clips,timelines, and sequences – Basic and advanced editing techniques – Transitions and effects– Colorcorrectionandbasiccolorgrading – Workingwithaudiotracks – Titlesandcaptions – Media organization and preferences – Introduction to modern NLE tools:Final Cut Pro-Adobe PremierePro- DaVinciResolve                                          |                                                                                                                                       |                       |                          |   |     |       |
| Unit-5                                                                                                                                                                                                                                                                                                                                                          | ADVANCEDPOST-PRODUCTIONANDEMERGINGTECHNOLOGIES                                                                                        |                       |                          |   | C05 | 9Hrs  |
| Motion graphics and visual effects basics– Introduction tocompositing– AI-assistedediting tools(autocuts,noise reduction, upscaling) – Multicam editing – Sound mixing and mastering – Exporting forOTT platforms –Basicsof VR/360° video–Introduction tolivestreaming workflows– Ethicsandcopyrightissuesindigitalvideo – Career pathways in video production. |                                                                                                                                       |                       |                          |   |     |       |
| TotalHours                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                       |                       |                          |   |     | 45Hrs |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                       |                       |                          |   |     |       |
| 1                                                                                                                                                                                                                                                                                                                                                               | KeithUnderdahl, “DigitalVideoforDummies”, ThirdEdition, DummySeries,2001.                                                             |                       |                          |   |     |       |
| 2                                                                                                                                                                                                                                                                                                                                                               | RobertM.GoodmanandPartickMcGarth,“EditingDigitalVideo:TheCompleteCreativeand TechnicalGuide”, DigitalVideoandAudio, McGraw – Hill2003 |                       |                          |   |     |       |

| Reference Books: |                                                                                                                                                                                           |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                | Wallace Jackson, Digital Video Editing Fundamentals, Apress.                                                                                                                              |
| 2                | Walter Murch, In the Blink of an Eye: A Perspective on Film Editing, Silman-James Press.                                                                                                  |
| 3                | Stu Maschwitz, The DV Rebel's Guide, Peachpit Press.                                                                                                                                      |
| Web References:  |                                                                                                                                                                                           |
| 1                | <a href="https://digitalnz.org/make-it-digital/creating-digital-content/creating-digital-video">https://digitalnz.org/make-it-digital/creating-digital-content/creating-digital-video</a> |
| 2                | <a href="https://www.agitraining.com/">https://www.agitraining.com/</a>                                                                                                                   |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 20%                   |                | 20%                  |            |            |                          |
| Apply                                                       | 80%                   | 100%           | 80%                  |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 marks.
- Experiment wise laboratory completion 10 marks and Model lab exam will be conducted for 100 marks and the same will be converted to 10 marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C502.1      | 2    | 2    | –    | –    | 1    | –    | –    | 2    | –    | –     | –     | 1     | –     |
| C502.2      | 2    | 2    | 3    | –    | 2    | –    | –    | –    | 2    | 3     | –     | 2     | 1     |
| C502.3      | 2    | 2    | 3    | 1    | 3    | –    | –    | –    | 2    | 3     | –     | 3     | 2     |
| C502.4      | 2    | 2    | 3    | 1    | 3    | –    | –    | –    | 2    | 2     | –     | 3     | 2     |
| C502.5      | 2    | 3    | 2    | 2    | 2    | –    | 1    | 1    | –    | 1     | –     | 2     | 3     |

1-low, 2-medium, 3-high, '–' - no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                    | Course Name                                                                                                                                                                                                       | Category               | Hours/Week                |   |   | C    |   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|---|
|                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                   |                        | L                         | T | P |      |   |
| 24AM503                                                                                                                                                                                                                                                                                                                                        | DIGITAL MARKETING                                                                                                                                                                                                 | PE                     | 3                         | 0 | 0 | 3    |   |
| Regulation                                                                                                                                                                                                                                                                                                                                     | Nature of the Course                                                                                                                                                                                              | Semester               | Data Book/Codes/Standards |   |   |      |   |
| 2024                                                                                                                                                                                                                                                                                                                                           | THEORY                                                                                                                                                                                                            | -                      | -                         |   |   |      |   |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                   | Co-requisite Course(s) |                           |   |   |      |   |
| Nil                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                   | Nil                    |                           |   |   |      |   |
| Course Objectives                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                              | To Understand the fundamentals and importance of digital marketing in modern business.                                                                                                                            |                        |                           |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                                                              | To Learn the concepts of search engine optimization (SEO) and search engine marketing (SEM).                                                                                                                      |                        |                           |   |   |      |   |
| 3                                                                                                                                                                                                                                                                                                                                              | To Apply social media and content marketing strategies.                                                                                                                                                           |                        |                           |   |   |      |   |
| 4                                                                                                                                                                                                                                                                                                                                              | To Apply email marketing and online advertising techniques                                                                                                                                                        |                        |                           |   |   |      |   |
| 5                                                                                                                                                                                                                                                                                                                                              | To Analyze digital marketing performance using analytics tools.                                                                                                                                                   |                        |                           |   |   |      |   |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| C504.1                                                                                                                                                                                                                                                                                                                                         | Understand digital marketing concepts and tools.                                                                                                                                                                  |                        |                           |   |   | [U]  |   |
| C504.2                                                                                                                                                                                                                                                                                                                                         | Implement SEO and search engine marketing strategies.                                                                                                                                                             |                        |                           |   |   | [AP] |   |
| C504.3                                                                                                                                                                                                                                                                                                                                         | Develop social media marketing campaigns.                                                                                                                                                                         |                        |                           |   |   | [AP] |   |
| C504.4                                                                                                                                                                                                                                                                                                                                         | Apply email marketing and online advertising techniques.                                                                                                                                                          |                        |                           |   |   | [AP] |   |
| C504.5                                                                                                                                                                                                                                                                                                                                         | Analyze digital marketing performance using analytics tools.                                                                                                                                                      |                        |                           |   |   | [AN] |   |
| Course Contents Hrs                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| Unit-1                                                                                                                                                                                                                                                                                                                                         | FUNDAMENTALS OF DIGITAL MARKETING                                                                                                                                                                                 |                        |                           |   |   | C01  | 9 |
| Introduction to Marketing and Digital Marketing, Traditional Marketing vs Digital Marketing, Digital Marketing Ecosystem, Online Consumer Behaviour, Digital Marketing Channels: Search Engines, Social Media, Email, Mobile Marketing. Website planning and development, Content marketing fundamentals, Digital marketing strategy framework |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| Unit-2                                                                                                                                                                                                                                                                                                                                         | SEARCH ENGINE OPTIMIZATION (SEO) & SEARCH MARKETING                                                                                                                                                               |                        |                           |   |   | C02  | 9 |
| Search engines and their working, Keyword research techniques, On-page SEO: Metatags, Title tags, Internal linking. Off-page SEO: Backlinks, Directory submissions, Social bookmarking. Technical SEO, Search Engine Marketing (SEM), Pay-Per-Click (PPC) advertising, Google Ads basics                                                       |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| Unit-3                                                                                                                                                                                                                                                                                                                                         | SOCIAL MEDIA & CONTENT MARKETING                                                                                                                                                                                  |                        |                           |   |   | C03  | 9 |
| Social media platform overview: Facebook, Instagram, LinkedIn, YouTube, Twitter. Social media marketing strategy, Content creation and storytelling, Blogging and microblogging, Influencer marketing, Online reputation management, Social media advertising                                                                                  |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| Unit-4                                                                                                                                                                                                                                                                                                                                         | EMAIL MARKETING & ONLINE ADVERTISING                                                                                                                                                                              |                        |                           |   |   | C04  | 9 |
| Email marketing fundamentals, Email campaign design, Email automation, Customer segmentation, Lead generation strategies, Display advertising, Affiliate marketing, Mobile marketing, Retargeting and remarketing                                                                                                                              |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| Unit-5                                                                                                                                                                                                                                                                                                                                         | DIGITAL MARKETING ANALYTICS & EMERGING TRENDS                                                                                                                                                                     |                        |                           |   |   | C05  | 9 |
| Web analytics fundamentals, Google Analytics overview, Conversion rate optimization (CRO), Marketing performance metrics: CTR, CPC, ROI. Conversion rate, Data-driven marketing decisions, Marketing automation tools, Artificial Intelligence in marketing, Future trends in digital marketing                                                |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| Total Hours                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                   |                        |                           |   |   | 45   |   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                              | Dave Chaffey and Fiona Ellis-Chadwick, Digital Marketing: Strategy, Implementation and Practice, 8th Edition, Pearson Education, 2022, ISBN: 978-1292400969.                                                      |                        |                           |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                                                              | Seema Gupta, Digital Marketing, 2nd Edition, McGraw Hill Education, 2023, ISBN: 978-9355324245.                                                                                                                   |                        |                           |   |   |      |   |
| 3                                                                                                                                                                                                                                                                                                                                              | Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns, 1st Edition, John Wiley & Sons (Wiley Publications), 2016, ISBN: 978-1119265702. |                        |                           |   |   |      |   |
| Reference Books:                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                   |                        |                           |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                              | Philip Kotler, Hermawan Kartajaya and Iwan Setiawan, Marketing 4.0: Moving from Traditional to Digital, 1st Edition, John Wiley & Sons (Wiley), 2017, ISBN: 978-1119341208.                                       |                        |                           |   |   |      |   |

|                        |                                                                                                                                                                                                          |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2                      | Ryan Deiss and Russ Henneberry, Digital Marketing for Dummies, 2nd Edition, Wiley, 2020, ISBN: 978-1119660484.                                                                                           |
| 3                      | Joe Pulizzi, Epic Content Marketing: How to Tell a Different Story, Break Through the Clutter, and Win More Customers by Marketing Less, 2nd Edition, McGraw Hill Education, 2014, ISBN: 978-0071819893. |
| <b>Web References:</b> |                                                                                                                                                                                                          |
| 1                      | <a href="https://nptel.ac.in/courses/110105920">https://nptel.ac.in/courses/110105920</a>                                                                                                                |
| 2                      | <a href="https://swayam.gov.in/search_courses?searchText=digital%20marketing">https://swayam.gov.in/search_courses?searchText=digital%20marketing</a>                                                    |
| 3                      | <a href="https://skillshop.exceedlms.com/student/catalog/list?category_ids=7879-google-digital-garage">https://skillshop.exceedlms.com/student/catalog/list?category_ids=7879-google-digital-garage</a>  |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 80                    | 20             | 20                   |            |            |                          |
| Apply                                                       | 20                    | 80             | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PS01 | PS02 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|------|------|
| C504.1      | 3    | 2    | -    | -    | -    | -    | -    | -    | -    | -     | -     | 1    | 2    |
| C504.2      | 3    | 3    | 2    | -    | 2    | -    | -    | -    | -    | -     | 3     | 2    | 2    |
| C504.3      | 2    | 3    | 3    | -    | 2    | -    | -    | -    | 2    | 2     | 3     | 1    | 2    |
| C504.4      | 2    | 2    | 3    | -    | 2    | -    | -    | -    | 2    | 2     | -     | 1    | 2    |
| C504.5      | 3    | 3    | 2    | 2    | 3    | -    | -    | -    | -    | 2     | 3     | 2    | 3    |

1-low, 2-medium, 3-high, '-'-no correlation

**VERTICALV  
LANGUAGEMODELLING**

| Course Code                                                                                                                                                                                                                                                                                                            | Course Name                                                                                                 | Category               | Hours/Week                |   |   | C  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----|
|                                                                                                                                                                                                                                                                                                                        |                                                                                                             |                        | L                         | T | P |    |
| 24AM506                                                                                                                                                                                                                                                                                                                | LINGUISTIC ENGINEERING                                                                                      | PE                     | 3                         | 0 | 0 | 3  |
| Regulation                                                                                                                                                                                                                                                                                                             | Nature of the Course                                                                                        | Semester               | Data Book/Codes/Standards |   |   |    |
| R24                                                                                                                                                                                                                                                                                                                    | THEORY                                                                                                      | -                      | -----                     |   |   |    |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                |                                                                                                             | Co-requisite Course(s) |                           |   |   |    |
| -                                                                                                                                                                                                                                                                                                                      |                                                                                                             | -                      |                           |   |   |    |
| Course Objectives                                                                                                                                                                                                                                                                                                      |                                                                                                             |                        |                           |   |   |    |
| 1                                                                                                                                                                                                                                                                                                                      | To understand the fundamentals of linguistics and computational linguistics.                                |                        |                           |   |   |    |
| 2                                                                                                                                                                                                                                                                                                                      | To learn lexical, syntactic and semantic analysis techniques used in language processing.                   |                        |                           |   |   |    |
| 3                                                                                                                                                                                                                                                                                                                      | To apply statistical and machine learning approaches in natural language processing.                        |                        |                           |   |   |    |
| 4                                                                                                                                                                                                                                                                                                                      | To implement language models and text processing techniques.                                                |                        |                           |   |   |    |
| 5                                                                                                                                                                                                                                                                                                                      | To develop AI based language applications such as chatbots, translation and sentiment analysis.             |                        |                           |   |   |    |
| Course Outcomes                                                                                                                                                                                                                                                                                                        |                                                                                                             |                        |                           |   |   |    |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                |                                                                                                             |                        |                           |   |   |    |
| C506.1                                                                                                                                                                                                                                                                                                                 | Explain linguistic concepts and structure of natural language                                               |                        |                           |   |   | U  |
| C506.2                                                                                                                                                                                                                                                                                                                 | Apply lexical and syntactic processing techniques                                                           |                        |                           |   |   | AP |
| C506.3                                                                                                                                                                                                                                                                                                                 | Implement semantic analysis and language models                                                             |                        |                           |   |   | AP |
| C506.4                                                                                                                                                                                                                                                                                                                 | Analyze NLP techniques using machine learning methods                                                       |                        |                           |   |   | AN |
| C506.5                                                                                                                                                                                                                                                                                                                 | Develop AI-based language applications                                                                      |                        |                           |   |   | AP |
| Course Contents                                                                                                                                                                                                                                                                                                        |                                                                                                             |                        |                           |   |   |    |
| Unit -1                                                                                                                                                                                                                                                                                                                | FUNDAMENTALS OF LINGUISTICS AND NLP                                                                         |                        |                           |   |   | 9  |
| Introduction to Linguistic Engineering – Natural Language vs Formal Language – Applications of NLP – Levels of Language Analysis – Morphology – Phonology – Syntax – Semantics – Pragmatics – Corpus Linguistics – Text Corpora and Annotation – Overview of NLP pipeline – Challenges in Natural Language Processing. |                                                                                                             |                        |                           |   |   |    |
| Unit -2                                                                                                                                                                                                                                                                                                                | LEXICAL ANALYSIS AND MORPHOLOGY                                                                             |                        |                           |   |   | 9  |
| Word structure and morphology – Tokenization – Stemming and Lemmatization – Stop word removal – Regular expressions in NLP – Finite State Automata for morphology – Part of Speech (POS) tagging – Rule-based and statistical POS tagging – N-gram models – Language modeling basics.                                  |                                                                                                             |                        |                           |   |   |    |
| Unit -3                                                                                                                                                                                                                                                                                                                | SYNTACTIC ANALYSIS                                                                                          |                        |                           |   |   | 9  |
| Context Free Grammar (CFG) – Parsing techniques – Top-down parsing – Bottom-up parsing – Chart parsing – Dependency parsing – Treebanks – Syntactic ambiguity – Parsing algorithms – Applications of syntactic analysis.                                                                                               |                                                                                                             |                        |                           |   |   |    |
| Unit -4                                                                                                                                                                                                                                                                                                                | SEMANTIC AND DISCOURSE PROCESSING                                                                           |                        |                           |   |   | 9  |
| Semantic representation – First order predicate logic – Word sense disambiguation – Semantic role labeling – Named Entity Recognition – Coreference resolution – Discourse analysis – Pragmatic processing – Information extraction techniques.                                                                        |                                                                                                             |                        |                           |   |   |    |
| Unit -5                                                                                                                                                                                                                                                                                                                | MACHINE LEARNING FOR NLP APPLICATIONS                                                                       |                        |                           |   |   | 9  |
| Text classification – Sentiment analysis – Topic modeling – Information retrieval basics – Machine learning techniques in NLP – Deep learning for NLP – Word embeddings – Transformers and language models – Chatbots – Machine translation – Question answering systems.                                              |                                                                                                             |                        |                           |   |   |    |
| Total Hours                                                                                                                                                                                                                                                                                                            |                                                                                                             |                        |                           |   |   | 45 |
| Textbooks:                                                                                                                                                                                                                                                                                                             |                                                                                                             |                        |                           |   |   |    |
| 1                                                                                                                                                                                                                                                                                                                      | Daniel Jurafsky and James H. Martin, Speech and Language Processing, Pearson Education.                     |                        |                           |   |   |    |
| 2                                                                                                                                                                                                                                                                                                                      | James Allen, Natural Language Understanding, Pearson.                                                       |                        |                           |   |   |    |
| Reference Books:                                                                                                                                                                                                                                                                                                       |                                                                                                             |                        |                           |   |   |    |
| 1                                                                                                                                                                                                                                                                                                                      | Christopher Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing, MIT Press. |                        |                           |   |   |    |
| 2                                                                                                                                                                                                                                                                                                                      | Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, O'Reilly.                   |                        |                           |   |   |    |

|   |                                                                                 |
|---|---------------------------------------------------------------------------------|
| 3 | YoavGoldberg, NeuralNetworkMethodsinnaturalLanguageProcessing, Morgan&Claypool. |
| 4 | Jacob Eisenstein, Introduction to Natural Language Processing, MIT Press.       |

| AssessmentbasedonContinuousandEndSemesterExamination |                      |               |                    |            |            |                         |
|------------------------------------------------------|----------------------|---------------|--------------------|------------|------------|-------------------------|
| Bloom's Level                                        | CONTINUOUSASSESSMENT |               |                    | ASSIGNMENT | ATTENDANCE | ENDSEMESTER EXAMINATION |
|                                                      | CIA1 (6Marks)        | CIA2 (6Marks) | ModelExam (8Marks) |            |            |                         |
| Remember                                             |                      |               |                    | (10Marks)  | (10Marks)  | (60Marks)               |
| Understand                                           | 80%                  | 20%           | 20%                |            |            |                         |
| Apply                                                | 20%                  | 80%           | 80%                |            |            |                         |
| Analyze                                              |                      |               |                    |            |            |                         |
| Evaluate                                             |                      |               |                    |            |            |                         |
| Create                                               |                      |               |                    |            |            |                         |
| <b>Total (100Marks)</b>                              | <b>6</b>             | <b>6</b>      | <b>8</b>           | <b>10</b>  | <b>10</b>  | <b>60</b>               |

• CIA1, CIA2andModelExamwillbeconductedfor50,50and100marks.Itshallbe subsequently converted to 6, 6 and 8 marks respectively.

• TheAssignmentmarkswillbecomputedbasedonAssignmentI, AssignmentIIandAssignmentIIImarksconvertedto10 Marks.

• BTL mark split up may vary based on thenatureofthesubject.

| COs/<br>POs | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P010 | P011 | PS01 | PS02 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| C506.1      | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | 2    | -    | 3    |
| C506.2      | 3   | 3   | 2   | -   | 2   | -   | -   | -   | -   | -    | 2    | -    | 3    |
| C506.3      | 3   | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -    | 2    | -    | 3    |
| C506.4      | 3   | 3   | 2   | 2   | 2   | -   | -   | -   | -   | -    | 2    | -    | 3    |
| C506.5      | 3   | 2   | 3   | 2   | 3   | -   | -   | -   | -   | -    | 2    | -    | 3    |

**3-Strong2-Moderate1-Weak--nocorrelation**

| Course Code                                                                                                                                                                                                                                                            | Course Name                                                                                                                               | Category                             | Hours/Week                            |   |   | C               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|---------------------------------------|---|---|-----------------|
|                                                                                                                                                                                                                                                                        |                                                                                                                                           |                                      | L                                     | T | P |                 |
| 24AM507                                                                                                                                                                                                                                                                | SOFT COMPUTING                                                                                                                            | PE                                   | 3                                     | 0 | 0 | 3               |
| <b>Regulation</b><br>R24                                                                                                                                                                                                                                               | <b>Nature of the Course</b><br>THEORY                                                                                                     | <b>Semester</b><br>-                 | <b>Data Book/Codes/Standards</b><br>- |   |   |                 |
| <b>Pre-requisite Course(s)</b><br>Artificial Intelligence                                                                                                                                                                                                              |                                                                                                                                           | <b>Co-requisite Course(s)</b><br>Nil |                                       |   |   |                 |
| <b>Course Objectives</b>                                                                                                                                                                                                                                               |                                                                                                                                           |                                      |                                       |   |   |                 |
| 1                                                                                                                                                                                                                                                                      | To understand the fundamental concepts of soft computing and its components such as neural networks, fuzzy logic, and genetic algorithms. |                                      |                                       |   |   |                 |
| 2                                                                                                                                                                                                                                                                      | To study the structure and learning mechanisms of artificial neural networks and their applications.                                      |                                      |                                       |   |   |                 |
| 3                                                                                                                                                                                                                                                                      | To learn the principles of fuzzy logic and apply fuzzy systems to solve real-world problems.                                              |                                      |                                       |   |   |                 |
| 4                                                                                                                                                                                                                                                                      | To understand the working of genetic algorithms and their use in optimization problems.                                                   |                                      |                                       |   |   |                 |
| 5                                                                                                                                                                                                                                                                      | To explore hybrid soft computing techniques and their applications in various domains.                                                    |                                      |                                       |   |   |                 |
| <b>Course Outcomes</b>                                                                                                                                                                                                                                                 |                                                                                                                                           |                                      |                                       |   |   |                 |
| <b>Upon completion of the course, students will be able to</b>                                                                                                                                                                                                         |                                                                                                                                           |                                      |                                       |   |   |                 |
| C507.1                                                                                                                                                                                                                                                                 | Understand the basic concepts and components of soft computing.                                                                           |                                      |                                       |   |   | [U]             |
| C507.2                                                                                                                                                                                                                                                                 | Explain the structure and working of artificial neural networks.                                                                          |                                      |                                       |   |   | [U]             |
| C507.3                                                                                                                                                                                                                                                                 | Apply fuzzy logic concepts to solve simple problems.                                                                                      |                                      |                                       |   |   | [AP]            |
| C507.4                                                                                                                                                                                                                                                                 | Analyze genetic algorithms and their operations.                                                                                          |                                      |                                       |   |   | [U]             |
| C507.5                                                                                                                                                                                                                                                                 | Evaluate hybrid soft computing techniques and their applications.                                                                         |                                      |                                       |   |   | [AP]            |
| <b>Course Contents</b>                                                                                                                                                                                                                                                 |                                                                                                                                           |                                      |                                       |   |   |                 |
| <b>Unit-1</b>                                                                                                                                                                                                                                                          | INTRODUCTION TO SOFT COMPUTING                                                                                                            |                                      |                                       |   |   | <b>C01 9Hrs</b> |
| Introduction to Soft Computing – Difference between Soft Computing and Hard Computing – Applications of Soft Computing – Components of Soft Computing – Neural Networks – Fuzzy Logic – Genetic Algorithms – Hybrid Systems – Advantages of Soft Computing Techniques. |                                                                                                                                           |                                      |                                       |   |   |                 |
| <b>Unit-2</b>                                                                                                                                                                                                                                                          | ARTIFICIAL NEURAL NETWORKS                                                                                                                |                                      |                                       |   |   | <b>C02 9Hrs</b> |
| Biological Neural Network – Artificial Neuron Model – Neural Network Architecture – Activation Functions – Learning Methods – Supervised Learning – Unsupervised Learning – Single Layer Perceptron – Multi Layer Perceptron – Applications of Neural Networks.        |                                                                                                                                           |                                      |                                       |   |   |                 |
| <b>Unit-3</b>                                                                                                                                                                                                                                                          | FUZZY LOGIC                                                                                                                               |                                      |                                       |   |   | <b>C03 9Hrs</b> |
| Introduction to Fuzzy Logic – Crisp Sets and Fuzzy Sets – Membership Functions – Fuzzy Operations – Fuzzy Rules – Fuzzy Inference System – Defuzzification Methods – Applications of Fuzzy Logic in Control Systems.                                                   |                                                                                                                                           |                                      |                                       |   |   |                 |
| <b>Unit-4</b>                                                                                                                                                                                                                                                          | GENETIC ALGORITHMS                                                                                                                        |                                      |                                       |   |   | <b>C04 9Hrs</b> |
| Introduction to Genetic Algorithms – Basic Concepts – Genetic Representation – Fitness Function – Selection Methods – Crossover Operation – Mutation Operation – Genetic Algorithm Cycle – Applications of Genetic Algorithms.                                         |                                                                                                                                           |                                      |                                       |   |   |                 |
| <b>Unit-5</b>                                                                                                                                                                                                                                                          | HYBRID SYSTEMS AND APPLICATIONS                                                                                                           |                                      |                                       |   |   | <b>C05 9Hrs</b> |
| Neuro-Fuzzy Systems – Genetic Neural Networks – Hybrid Soft Computing Techniques – Applications of Soft Computing in Pattern Recognition – Image Processing – Optimization Problems – Data Mining – Future Trends in Soft Computing.                                   |                                                                                                                                           |                                      |                                       |   |   |                 |
| <b>Total Hours</b>                                                                                                                                                                                                                                                     |                                                                                                                                           |                                      |                                       |   |   | <b>45</b>       |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                      |                                                                                                                                           |                                      |                                       |   |   |                 |
| 1                                                                                                                                                                                                                                                                      | S. Rajasekaran & G.A. Vijayalakshmi Pai, <b>Neural Networks, Fuzzy Logic and Genetic Algorithms</b> , PHI.                                |                                      |                                       |   |   |                 |
| 2                                                                                                                                                                                                                                                                      | S. N. Sivanandam & S. N. Deepa, <b>Principles of Soft Computing</b> , Wiley.                                                              |                                      |                                       |   |   |                 |
| 3                                                                                                                                                                                                                                                                      | Timothy J. Ross, <b>Fuzzy Logic with Engineering Applications</b> , Wiley.                                                                |                                      |                                       |   |   |                 |
| <b>Reference Books:</b>                                                                                                                                                                                                                                                |                                                                                                                                           |                                      |                                       |   |   |                 |
| 1                                                                                                                                                                                                                                                                      | David E. Goldberg, <b>Genetic Algorithms in Search, Optimization and Machine Learning</b> , Addison Wesley.                               |                                      |                                       |   |   |                 |
| 2                                                                                                                                                                                                                                                                      | Jang, Sun & Mizutani, <b>Neuro-Fuzzy and Soft Computing</b> , PHI Learning Pvt. Ltd., 2003                                                |                                      |                                       |   |   |                 |
| 3                                                                                                                                                                                                                                                                      | Simon Haykin, <b>Neural Networks and Learning Machines</b> , Pearson.                                                                     |                                      |                                       |   |   |                 |
| 4                                                                                                                                                                                                                                                                      | George J. Klir & Bo Yuan, <b>Fuzzy Sets and Fuzzy Logic: Theory and Application</b> , Prentice Hall.                                      |                                      |                                       |   |   |                 |
| <b>Web References:</b>                                                                                                                                                                                                                                                 |                                                                                                                                           |                                      |                                       |   |   |                 |
| 1                                                                                                                                                                                                                                                                      | <a href="https://nptel.ac.in/courses/106105173">https://nptel.ac.in/courses/106105173</a>                                                 |                                      |                                       |   |   |                 |
| 2                                                                                                                                                                                                                                                                      | <a href="https://swayam.gov.in">https://swayam.gov.in</a>                                                                                 |                                      |                                       |   |   |                 |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      |            |            |                          |
| Understand                                                  | 80                    | 20             | 20                   |            |            |                          |
| Apply                                                       | 20                    | 80             | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| C0s/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C507.1      | 3    | 2    | -    | -    | -    | -    | -    | -    | -    | -     | 1     | 2     | 1     | -     |
| C507.2      | 3    | 3    | 2    | -    | -    | -    | -    | -    | -    | -     | 1     | 3     | 2     | -     |
| C507.3      | 3    | 3    | 3    | 2    | -    | -    | -    | -    | -    | -     | 2     | 3     | 2     | 1     |
| C507.4      | 3    | 3    | 2    | 2    | 1    | -    | -    | -    | -    | -     | 2     | 3     | 2     | 1     |
| C507.5      | 3    | 3    | 3    | 2    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                     | Course Name                                                                                                                     | Category                   | Hours/Week                  |   |   | C        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|----------------------------|-----------------------------|---|---|----------|
|                                                                                                                                                                                                                                                 |                                                                                                                                 |                            | L                           | T | P |          |
| 24AM508                                                                                                                                                                                                                                         | COGNITIVE SCIENCE                                                                                                               | PE                         | 3                           | 0 | 0 | 3        |
| Regulation R24                                                                                                                                                                                                                                  | Nature of the Course THEORY                                                                                                     | Semester -                 | Data Book/Codes/Standards - |   |   |          |
| Pre-requisite Course(s) ARTIFICIAL INTELLIGENCE                                                                                                                                                                                                 |                                                                                                                                 | Co-requisite Course(s) Nil |                             |   |   |          |
| Course Objectives                                                                                                                                                                                                                               |                                                                                                                                 |                            |                             |   |   |          |
| 1                                                                                                                                                                                                                                               | Understand the basic concepts and interdisciplinary nature of cognitive science.                                                |                            |                             |   |   |          |
| 2                                                                                                                                                                                                                                               | Understand cognitive processes such as perception, memory, and problem solving.                                                 |                            |                             |   |   |          |
| 3                                                                                                                                                                                                                                               | Understand the structure and functions of the human brain related to cognition.                                                 |                            |                             |   |   |          |
| 4                                                                                                                                                                                                                                               | Apply computational models and artificial intelligence techniques in cognitive science.                                         |                            |                             |   |   |          |
| 5                                                                                                                                                                                                                                               | Apply cognitive science concepts in language processing and real-world applications.                                            |                            |                             |   |   |          |
| Course Outcomes                                                                                                                                                                                                                                 |                                                                                                                                 |                            |                             |   |   |          |
| Upon completion of the course, students will be able to                                                                                                                                                                                         |                                                                                                                                 |                            |                             |   |   |          |
| C508.1                                                                                                                                                                                                                                          | Explain the fundamental concepts and interdisciplinary aspects of cognitive science.                                            |                            |                             |   |   | [U]      |
| C508.2                                                                                                                                                                                                                                          | Describe various cognitive processes such as attention, perception, and memory.                                                 |                            |                             |   |   | [U]      |
| C508.3                                                                                                                                                                                                                                          | Illustrate the role of the human brain and neural mechanisms in cognition.                                                      |                            |                             |   |   | [U]      |
| C508.4                                                                                                                                                                                                                                          | Apply computational models and reasoning techniques to simulate cognitive processes.                                            |                            |                             |   |   | [AP]     |
| C508.5                                                                                                                                                                                                                                          | Demonstrate the use of cognitive science principles in real-world applications such as AI and human-computer interaction.       |                            |                             |   |   | [AP]     |
| Course Contents                                                                                                                                                                                                                                 |                                                                                                                                 |                            |                             |   |   |          |
| Unit-1                                                                                                                                                                                                                                          | INTRODUCTION TO COGNITIVE SCIENCE                                                                                               |                            |                             |   |   | C01 9Hrs |
| Introduction to Cognitive Science – Interdisciplinary Nature – Relationship between Psychology, AI, Neuroscience, Linguistics and Philosophy – Human Cognition – Information Processing – Perception – Learning – Memory – Language Processing. |                                                                                                                                 |                            |                             |   |   |          |
| Unit-2                                                                                                                                                                                                                                          | COGNITIVE PSYCHOLOGY                                                                                                            |                            |                             |   |   | C02 9Hrs |
| Cognitive Psychology – Attention – Perception – Memory – Problem Solving – Decision Making – Representation of Knowledge – Cognitive Architecture – Information Processing Models.                                                              |                                                                                                                                 |                            |                             |   |   |          |
| Unit-3                                                                                                                                                                                                                                          | COGNITIVE NEUROSCIENCE                                                                                                          |                            |                             |   |   | C03 9Hrs |
| Brain and Cognition – Structure and Function of Nervous System – Neurons – Brain Mapping Techniques – Neural Representation – Cognitive Functions of Brain – Neuroplasticity – Case Studies.                                                    |                                                                                                                                 |                            |                             |   |   |          |
| Unit-4                                                                                                                                                                                                                                          | COMPUTATIONAL MODELS OF COGNITION                                                                                               |                            |                             |   |   | C04 9Hrs |
| Artificial Intelligence and Cognition – Knowledge Representation – Logical Reasoning – Inference Models – Probabilistic Models – Machine Learning Basics – Cognitive Architectures.                                                             |                                                                                                                                 |                            |                             |   |   |          |
| Unit-5                                                                                                                                                                                                                                          | LANGUAGE AND APPLICATIONS OF COGNITIVE SCIENCE                                                                                  |                            |                             |   |   | C05 9Hrs |
| Language Acquisition – Semantics – Cognitive Models of Language Processing – Applications in AI – Pattern Recognition – Human-Computer Interaction – Cognitive Systems – Future Trends.                                                         |                                                                                                                                 |                            |                             |   |   |          |
| Total Hours                                                                                                                                                                                                                                     |                                                                                                                                 |                            |                             |   |   | 45       |
| Textbooks:                                                                                                                                                                                                                                      |                                                                                                                                 |                            |                             |   |   |          |
| 1                                                                                                                                                                                                                                               | Margaret W. Matlin, <b>Cognition</b> , Wiley.                                                                                   |                            |                             |   |   |          |
| 2                                                                                                                                                                                                                                               | José Luis Bermúdez, <b>Cognitive Science: An Introduction to the Science of the Mind</b> , Cambridge University Press.          |                            |                             |   |   |          |
| 3                                                                                                                                                                                                                                               | Paul Thagard, <b>Mind: Introduction to Cognitive Science</b> , MIT Press.                                                       |                            |                             |   |   |          |
| Reference Books:                                                                                                                                                                                                                                |                                                                                                                                 |                            |                             |   |   |          |
| 1                                                                                                                                                                                                                                               | Jay Friedenberg & Gordon Silverman, <b>Cognitive Science: An Introduction to the Study of Mind</b> , Sage Publications.         |                            |                             |   |   |          |
| 2                                                                                                                                                                                                                                               | Daniel Reisberg, <b>Cognition: Exploring the Science of the Mind</b> , W.W. Norton.                                             |                            |                             |   |   |          |
| 3                                                                                                                                                                                                                                               | Michael S. Gazzaniga, Richard B. Ivry & George R. Mangun, <b>Cognitive Neuroscience: The Biology of the Mind</b> , W.W. Norton. |                            |                             |   |   |          |
| 4                                                                                                                                                                                                                                               | E. Bruce Goldstein, <b>Cognitive Psychology: Connecting Mind, Research, and Everyday Experience</b> , Cengage Learning.         |                            |                             |   |   |          |
| Web References:                                                                                                                                                                                                                                 |                                                                                                                                 |                            |                             |   |   |          |
| 1                                                                                                                                                                                                                                               | <a href="https://nptel.ac.in">https://nptel.ac.in</a>                                                                           |                            |                             |   |   |          |
| 2                                                                                                                                                                                                                                               | <a href="https://swayam.gov.in">https://swayam.gov.in</a>                                                                       |                            |                             |   |   |          |
| 3                                                                                                                                                                                                                                               | <a href="https://ocw.mit.edu">https://ocw.mit.edu</a>                                                                           |                            |                             |   |   |          |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 80                    | 80             | 20                   |            |            |                          |
| Apply                                                       | 20                    | 20             | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| C0s/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C508.1      | 3    | 2    | -    | -    | -    | -    | -    | -    | -    | -     | 1     | 2     | 1     | -     |
| C508.2      | 3    | 3    | 2    | -    | -    | -    | -    | -    | -    | -     | 1     | 3     | 2     | -     |
| C508.3      | 3    | 3    | 2    | 2    | -    | -    | -    | -    | -    | -     | 2     | 3     | 2     | 1     |
| C508.4      | 3    | 3    | 3    | 2    | 1    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 1     |
| C508.5      | 3    | 3    | 3    | 2    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 3     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                     | Course Name                                                                                                                                                                          | Category               | Hours/Week                |   |     | C    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-----|------|
|                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                      |                        | L                         | T | P   |      |
| 24AM509                                                                                                                                                                                                                                                                                                                         | ETHICAL HACKING                                                                                                                                                                      | PE                     | 3                         | 0 | 0   | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                      | Nature of the Course                                                                                                                                                                 | Semester               | Data Book/Codes/Standards |   |     |      |
| 2024                                                                                                                                                                                                                                                                                                                            | THEORY                                                                                                                                                                               | -                      | -                         |   |     |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                      | Co-requisite Course(s) |                           |   |     |      |
| OPERATING SYSTEMS                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                      | Nil                    |                           |   |     |      |
| Course Objectives                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                      |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                               | To understand the fundamentals of cyber security and ethical hacking.                                                                                                                |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                               | To identify vulnerabilities and security threats in computer networks and systems.                                                                                                   |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                               | To learn various hacking techniques and penetration testing methods.                                                                                                                 |                        |                           |   |     |      |
| 4                                                                                                                                                                                                                                                                                                                               | To analyze web application security vulnerabilities.                                                                                                                                 |                        |                           |   |     |      |
| 5                                                                                                                                                                                                                                                                                                                               | To understand security policies, cyber laws, and ethical practices.                                                                                                                  |                        |                           |   |     |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                      |                        |                           |   |     |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                         |                                                                                                                                                                                      |                        |                           |   |     |      |
| C509.1                                                                                                                                                                                                                                                                                                                          | Explain Cyber security principles and ethical hacking concepts.                                                                                                                      |                        |                           |   |     | [U]  |
| C509.2                                                                                                                                                                                                                                                                                                                          | Apply network scanning and vulnerability assessment techniques.                                                                                                                      |                        |                           |   |     | [AP] |
| C509.3                                                                                                                                                                                                                                                                                                                          | Analyze system security threats and malware attacks.                                                                                                                                 |                        |                           |   |     | [AN] |
| C509.4                                                                                                                                                                                                                                                                                                                          | Evaluate web application vulnerabilities and security mechanisms.                                                                                                                    |                        |                           |   |     | [AN] |
| C509.5                                                                                                                                                                                                                                                                                                                          | Perform penetration testing and implement security policies.                                                                                                                         |                        |                           |   |     | [AN] |
| Course Contents Hrs                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                      |                        |                           |   |     |      |
| Unit-1                                                                                                                                                                                                                                                                                                                          | FUNDAMENTALS OF ETHICAL HACKING                                                                                                                                                      |                        |                           |   | C01 | 9    |
| Introduction to Cyber Security and Ethical Hacking, Types of Hackers: White Hat, Black Hat, Grey Hat, Ethical Hacking Methodology and Phase, Cyber Threats and Vulnerabilities, Footprinting and Reconnaissance, Open Source Intelligence (OSINT), Information Gathering Techniques, Security Policies and Security Frameworks. |                                                                                                                                                                                      |                        |                           |   |     |      |
| Unit-2                                                                                                                                                                                                                                                                                                                          | NETWORK SCANNING AND VULNERABILITY ANALYSIS                                                                                                                                          |                        |                           |   | C02 | 9    |
| Network Scanning Techniques, Port Scanning and Network Mapping, Enumeration Techniques, Vulnerability Assessment and Risk Analysis, Packet Sniffing and Traffic Analysis, Intrusion Detection and Prevention Systems (IDS/IPS), Firewall Concepts and Network Security Protocols.                                               |                                                                                                                                                                                      |                        |                           |   |     |      |
| Unit-3                                                                                                                                                                                                                                                                                                                          | SYSTEM HACKING AND MALWARE ATTACKS                                                                                                                                                   |                        |                           |   | C03 | 9    |
| Password Cracking Techniques, Privilege Escalation, Malware Threats: Virus, Worms, Trojans, Ransomware, Rootkits and Backdoors, Keyloggers and Spyware, Steganography Concepts, System Security Countermeasures.                                                                                                                |                                                                                                                                                                                      |                        |                           |   |     |      |
| Unit-4                                                                                                                                                                                                                                                                                                                          | WEB APPLICATION HACKING                                                                                                                                                              |                        |                           |   | C04 | 9    |
| Web Application Architecture, Web Application Vulnerabilities, SQL Injection Attacks, Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), Session Hijacking and Cookie Attacks, Web Server Security, Secure Coding Practices.                                                                                        |                                                                                                                                                                                      |                        |                           |   |     |      |
| Unit-5                                                                                                                                                                                                                                                                                                                          | PENETRATION TESTING AND SECURITY MANAGEMENT                                                                                                                                          |                        |                           |   | C05 | 9    |
| Penetration Testing Methodology, Ethical Hacking Tools (Kali Linux, Nmap, Wireshark, Metasploit), Security Testing and Reporting, Incident Response and Risk Management, Digital Forensics Basics, Security Policies and Compliance, Cyber Laws and Ethical Issues.                                                             |                                                                                                                                                                                      |                        |                           |   |     |      |
| Total Theory Hours                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                      |                        |                           |   |     | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                      |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                               | Michael T. Simpson, Kent Backman and James Corley, Hands-On Ethical Hacking and Network Defense, 3rd Edition, Cengage Learning, 2016, ISBN: 978-1305078420.                          |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                               | Patrick Engebretson, The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy, 2nd Edition, Syngress (Elsevier), 2013, ISBN: 978-0124116443. |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                               | Kimberly Graves, CEH Official Certified Ethical Hacker Review Guide, 3rd Edition, Wiley, 2021, ISBN: 978-1119800286.                                                                 |                        |                           |   |     |      |
| Reference Books:                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                      |                        |                           |   |     |      |
| 1                                                                                                                                                                                                                                                                                                                               | Jon Erickson, Hacking: The Art of Exploitation, 2nd Edition, No Starch Press, 2008, ISBN: 978-1593271442.                                                                            |                        |                           |   |     |      |
| 2                                                                                                                                                                                                                                                                                                                               | Kevin Mitnick and William L. Simon, The Art of Deception: Controlling the Human Element of Security, 1st Edition, Wiley, 2002, ISBN: 978-0764542800.                                 |                        |                           |   |     |      |
| 3                                                                                                                                                                                                                                                                                                                               | Rafay Baloch, Ethical Hacking and Penetration Testing Guide, 1st Edition, CRC Press (Taylor & Francis), 2017, ISBN: 978-1138190238.                                                  |                        |                           |   |     |      |
| Web References:                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                      |                        |                           |   |     |      |



|   |                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------|
| 1 | <a href="https://nptel.ac.in/courses/106105217">https://nptel.ac.in/courses/106105217</a>                                   |
| 2 | <a href="https://owasp.org/search/?searchString=ethical+hacking">https://owasp.org/search/?searchString=ethical+hacking</a> |
| 3 | <a href="https://kali.org/">https://kali.org/</a>                                                                           |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 80                    | 20             | 20                   |            |            |                          |
| Apply                                                       | 20                    | 80             | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C509.1      | 3    | 2    | -    | -    | 1    | -    | -    | -    | -    | -     | 2     | 2     | 2     |
| C509.2      | 2    | 3    | 1    | 2    | 3    | -    | -    | -    | -    | -     | 2     | 2     | 3     |
| C509.3      | 2    | 3    | 1    | 2    | 2    | -    | -    | -    | -    | -     | 2     | 1     | 3     |
| C509.4      | 2    | 2    | 2    | 2    | 3    | -    | -    | -    | -    | -     | 2     | 1     | 3     |
| C509.5      | 3    | 2    | 2    | 2    | 3    | -    | -    | -    | -    | -     | 2     | 2     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                         | Course Name                                                                                                                                                                                                                                 | Category               | Hours/Week                |   |   | C        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----------|
|                                                                                                                                                                                                     |                                                                                                                                                                                                                                             |                        | L                         | T | P |          |
| 24AM510                                                                                                                                                                                             | OPTIMIZATION TECHNIQUES                                                                                                                                                                                                                     | PE                     | 3                         | 0 | 0 | 3        |
| Regulation 2024                                                                                                                                                                                     | Nature of the Course                                                                                                                                                                                                                        | Semester               | Data Book/Codes/Standards |   |   |          |
|                                                                                                                                                                                                     | THEORY                                                                                                                                                                                                                                      | -                      | -                         |   |   |          |
| Pre-requisite Course(s)                                                                                                                                                                             |                                                                                                                                                                                                                                             | Co-requisite Course(s) |                           |   |   |          |
| Artificial Intelligence, Machine Learning                                                                                                                                                           |                                                                                                                                                                                                                                             | Deep learning          |                           |   |   |          |
| Course Objectives                                                                                                                                                                                   |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| 1                                                                                                                                                                                                   | To formulate linear programming problems (LPP)                                                                                                                                                                                              |                        |                           |   |   |          |
| 2                                                                                                                                                                                                   | To evaluate Integer Programming Problems, Transportation and Assignment Problems                                                                                                                                                            |                        |                           |   |   |          |
| 3                                                                                                                                                                                                   | To obtain a solution to network problems using CPM and PERT techniques                                                                                                                                                                      |                        |                           |   |   |          |
| 4                                                                                                                                                                                                   | To optimize the function subject to the constraints                                                                                                                                                                                         |                        |                           |   |   |          |
| 5                                                                                                                                                                                                   | To identify and solve problems under Markovian queuing models                                                                                                                                                                               |                        |                           |   |   |          |
| Course Outcomes                                                                                                                                                                                     |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| Upon completion of the course, students will be able to                                                                                                                                             |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| C510.1                                                                                                                                                                                              | Solve linear programming problems (LPP)                                                                                                                                                                                                     |                        |                           |   |   | [AP]     |
| C510.2                                                                                                                                                                                              | Evaluate Integer Programming Problems, Transportation and Assignment Problems                                                                                                                                                               |                        |                           |   |   | [AP]     |
| C510.3                                                                                                                                                                                              | Obtain a solution to network problems using CPM and PERT techniques                                                                                                                                                                         |                        |                           |   |   | [AN]     |
| C510.4                                                                                                                                                                                              | Able to optimize the function subject to the constraints                                                                                                                                                                                    |                        |                           |   |   | [AN]     |
| C510.5                                                                                                                                                                                              | Solve problems under Markovian queuing models                                                                                                                                                                                               |                        |                           |   |   | [AP]     |
| Course Contents                                                                                                                                                                                     |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| Unit-1                                                                                                                                                                                              | LINEAR MODELS                                                                                                                                                                                                                               |                        |                           |   |   | C01 9Hrs |
| Introduction of Operations Research - mathematical formulation of LPP - Graphical Method to solve LPP - Simplex Method - Two-Phase method.                                                          |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| Unit-2                                                                                                                                                                                              | INTEGER PROGRAMMING AND TRANSPORTATION PROBLEMS                                                                                                                                                                                             |                        |                           |   |   | C02 9Hrs |
| Integer programming: Branch and bound method - Transportation and Assignment problems - Traveling salesman problem.                                                                                 |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| Unit-3                                                                                                                                                                                              | PROJECT SCHEDULING                                                                                                                                                                                                                          |                        |                           |   |   | C03 9Hrs |
| Project network - Diagram representation - Floats - Critical path method (CPM) - PERT - Cost considerations in PERT and CPM.                                                                        |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| Unit-4                                                                                                                                                                                              | CLASSICAL OPTIMIZATION THEORY                                                                                                                                                                                                               |                        |                           |   |   | C04 9Hrs |
| Unconstrained problems - necessary and sufficient conditions - Newton-Raphson method, Constrained problems - equality constraints - inequality constraints - Kuhn-Tucker conditions.                |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| Unit-5                                                                                                                                                                                              | QUEUING MODELS                                                                                                                                                                                                                              |                        |                           |   |   | C05 9Hrs |
| Introduction, Queuing Theory, Operating characteristics of a Queuing system, Constituent of a Queuing system, Service facility, Queue discipline, Single channel models, multiple service channels. |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| Total Hours                                                                                                                                                                                         |                                                                                                                                                                                                                                             |                        |                           |   |   | 45       |
| Textbooks:                                                                                                                                                                                          |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| 1                                                                                                                                                                                                   | Edwin K.P. Chong, Stanislaw H. Zak, "An Introduction to Optimization: With Applications to Machine Learning", 5th Edition, Wiley, 2023                                                                                                      |                        |                           |   |   |          |
| 2                                                                                                                                                                                                   | Faiz Hamid, "Optimization Essentials: Theory, Tools, and Applications", Springer Nature, 2025.                                                                                                                                              |                        |                           |   |   |          |
| 3                                                                                                                                                                                                   | Dr. Alaa Khamis, "Optimization Algorithms: Al techniques for design, planning, and control problems", Manning Publications., 2024.                                                                                                          |                        |                           |   |   |          |
| Reference Books:                                                                                                                                                                                    |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| 1                                                                                                                                                                                                   | Alessandro Zocca, Jeffrey C. Kantor, Krzysztof Postek, Joaquim A. S. Gromicho, "Hands-On Mathematical Optimization with Python", Cambridge University Press, 2025.                                                                          |                        |                           |   |   |          |
| 2                                                                                                                                                                                                   | Debashish Das, Ali Safaa Sadiq, Seyedali Mirjalili, "Optimization Algorithms in Machine Learning: A Meta-heuristics Perspective", Springer Singapore, 2025.                                                                                 |                        |                           |   |   |          |
| 3                                                                                                                                                                                                   | Anton Ereemeev, et al, "Mathematical Optimization Theory and Operations Research: Recent Trends ", Springer Nature Switzerland, 2024.                                                                                                       |                        |                           |   |   |          |
| Web References:                                                                                                                                                                                     |                                                                                                                                                                                                                                             |                        |                           |   |   |          |
| 1                                                                                                                                                                                                   | <a href="https://www.google.com/search?q=web+references+for+Introduction%2C+Queuing+Theory%2C+Operating+characteristics">https://www.google.com/search?q=web+references+for+Introduction%2C+Queuing+Theory%2C+Operating+characteristics</a> |                        |                           |   |   |          |
| 2                                                                                                                                                                                                   | <a href="https://qiml.radiology.wisc.edu/wp-content/uploads/sites/760/2021/03/lecture_A1_07_LineSearch.pdf">https://qiml.radiology.wisc.edu/wp-content/uploads/sites/760/2021/03/lecture_A1_07_LineSearch.pdf</a>                           |                        |                           |   |   |          |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 40                    | 20             | 40                   |            |            |                          |
| Apply                                                       | 60                    | 40             | 30                   |            |            |                          |
| Analyze                                                     |                       | 40             | 30                   |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C510.1      | 3    | 3    | 2    | 1    | 1    | -    | -    | -    | 2    | 1     | 2     | 3     | 3     |
| C510.2      | 3    | 2    | 2    | 2    | 3    | -    | -    | -    | 2    | 2     | 3     | 2     | 1     |
| C510.3      | 2    | 3    | 2    | 2    | 2    | -    | -    | -    | 3    | 3     | 3     | 2     | 3     |
| C510.4      | 2    | 2    | 3    | 3    | 3    | -    | -    | -    | 2    | 2     | 3     | 2     | 2     |
| C510.5      | 2    | 2    | 2    | 2    | 3    | -    | -    | -    | 2    | 2     | 3     | 2     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CourseName                                                                                                                        | Category               | Hours/Week                |   |             | C  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-------------|----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                   |                        | L                         | T | P           |    |
| 24AM511                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | RECOMMENDER SYSTEMS                                                                                                               | PEC                    | 3                         | 0 | 0           | 3  |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Nature of the Course                                                                                                              | Semester               | Data Book/Codes/Standards |   |             |    |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | THEORY                                                                                                                            | -                      | -                         |   |             |    |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                   | Co-requisite Course(s) |                           |   |             |    |
| Machine Learning, Data Structures and Algorithms                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                   |                        |                           |   |             |    |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                   |                        |                           |   |             |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | To understand the foundations of the recommender system.                                                                          |                        |                           |   |             |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | To learn the significance of machine learning and data mining algorithms for Recommender systems                                  |                        |                           |   |             |    |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | To learn about collaborative filtering                                                                                            |                        |                           |   |             |    |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | To make students design and implement a recommender system.                                                                       |                        |                           |   |             |    |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | To learn collaborative filtering.                                                                                                 |                        |                           |   |             |    |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                   |                        |                           |   |             |    |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                   |                        |                           |   |             |    |
| C511.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Understand and learn the basic concepts of recommender systems.                                                                   |                        |                           |   |             | U  |
| C511.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Implement machine-learning and data-mining algorithms in recommender systems datasets                                             |                        |                           |   |             | AP |
| C511.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics. |                        |                           |   |             | AP |
| C511.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Design and implement attack-resistant and knowledge based recommender systems.                                                    |                        |                           |   |             | AP |
| C511.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Apply different metrics to evaluate recommender systems                                                                           |                        |                           |   |             | AP |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                   |                        |                           |   |             |    |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | INTRODUCTION                                                                                                                      |                        |                           |   | C01         | 9  |
| Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses; covariance matrices - Overview of data mining methods for recommender systems - similarity measures - Dimensionality reduction - Singular Value Decomposition (SVD)                                                                                                                |                                                                                                                                   |                        |                           |   |             |    |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | CONTENT-BASED RECOMMENDATION SYSTEMS                                                                                              |                        |                           |   | C02         | 9  |
| High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms - Hybrid approaches: Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies. |                                                                                                                                   |                        |                           |   |             |    |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | COLLABORATIVE FILTERING                                                                                                           |                        |                           |   | C03         | 9  |
| A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection - Model based and pre-processing based approaches, Attacks on collaborative recommender systems                                                                                                                                                                   |                                                                                                                                   |                        |                           |   |             |    |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | ATTACK-RESISTANT AND KNOWLEDGE BASED RECOMMENDER SYSTEMS                                                                          |                        |                           |   | C04         | 9  |
| Introduction - Types of Attacks - Detecting attacks on recommender systems - Individual attack - Group attack - Strategies for robust recommender design - Robust recommendation algorithms. Knowledge based recommendation: Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders.                                                                                                                                                              |                                                                                                                                   |                        |                           |   |             |    |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | EVALUATING RECOMMENDER SYSTEMS                                                                                                    |                        |                           |   | C05         | 9  |
| Evaluating Paradigms - User Studies - Online and Offline evaluation - Goals of evaluation design - Design Issues Evaluation measures                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                   |                        |                           |   |             |    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                   |                        |                           |   | Total Hours | 45 |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                   |                        |                           |   |             |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Francesco Ricci, Lior Rokach, Bracha Shapira, Recommender Systems Handbook, Springer, 3rd Edition, 2022.                          |                        |                           |   |             |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | P. Pavan Kumar et al., Recommender Systems: Algorithms and Applications, CRC Press, 2021.                                         |                        |                           |   |             |    |
| Reference Books:                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                   |                        |                           |   |             |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Recommender Systems: The Textbook by Charu C. Aggarwal for comprehensive theory,                                                  |                        |                           |   |             |    |



|                       |                                                                                                                                                                       |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | and Recommender Systems Handbook(3rd Edition, 2022)                                                                                                                   |
| 2                     | RecommenderSystemsHandbook(Ricci,Rokach,Shapira,3rdEd.2022):Adefinitivecollectionofchapters by experts covering algorithms, evaluation, and specialized applications. |
| <b>WebReferences:</b> |                                                                                                                                                                       |
| 1                     | <a href="https://onlinecourses.nptel.ac.in/noc24_ge35/preview">https://onlinecourses.nptel.ac.in/noc24_ge35/preview</a>                                               |
| 2                     | <a href="https://en.wikipedia.org/wiki/Recommender_system">https://en.wikipedia.org/wiki/Recommender_system</a>                                                       |

| <b>AssessmentbasedonContinuousandEndSemesterExamination</b> |                             |                          |                               |                   |                   |                                    |
|-------------------------------------------------------------|-----------------------------|--------------------------|-------------------------------|-------------------|-------------------|------------------------------------|
| <b>BLOOM'S<br/>TAXONOMY<br/>LEVEL</b>                       | <b>CONTINUOUSASSESSMENT</b> |                          |                               | <b>ASSIGNMENT</b> | <b>ATTENDANCE</b> | <b>ENDSEMESTERE<br/>XAMINATION</b> |
|                                                             | <b>CIA1<br/>(6Marks)</b>    | <b>CIA2<br/>(6Marks)</b> | <b>ModelExam<br/>(8Marks)</b> | <b>(10Marks)</b>  | <b>(10Marks)</b>  | <b>(60Marks)</b>                   |
| Remember                                                    |                             |                          |                               | 10                | 10                | 60                                 |
| Understand                                                  | 40%                         |                          | 20%                           |                   |                   |                                    |
| Apply                                                       | 60%                         | 100%                     | 80%                           |                   |                   |                                    |
| Analyze                                                     |                             |                          |                               |                   |                   |                                    |
| Evaluate                                                    |                             |                          |                               |                   |                   |                                    |
| Create                                                      |                             |                          |                               |                   |                   |                                    |
| <b>Total<br/>(100Marks)</b>                                 | <b>6</b>                    | <b>6</b>                 | <b>8</b>                      | <b>10</b>         | <b>10</b>         | <b>60</b>                          |

- CIA1, CIA2andModelExamwillbeconductedfor50,50and100marks.Itshallbe subsequently converted to 6, 6 and 8 marks respectively.
- TheAssignmentmarkswillbecomputedbasedonAssignmentI, AssignmentIIandAssignmentIIImarksconvertedto10 Marks.
- BTL mark split up may vary based on thenatureofthesubject.

| <b>COs/<br/>Pos</b> | <b>PO<br/>1</b> | <b>PO<br/>2</b> | <b>PO<br/>3</b> | <b>PO<br/>4</b> | <b>PO<br/>5</b> | <b>PO<br/>6</b> | <b>PO<br/>7</b> | <b>PO<br/>8</b> | <b>PO<br/>9</b> | <b>PO<br/>10</b> | <b>PO<br/>11</b> | <b>PSO<br/>1</b> | <b>PSO2</b> |
|---------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|-------------|
| C511.1              | 3               | 3               | 3               | 2               | 1               | -               | -               | -               | -               | -                | -                | 3                | -           |
| C511.2              | 3               | 3               | 2               | 2               | 1               | -               | -               | -               | -               | -                | -                | 3                | -           |
| C511.3              | 3               | 2               | 3               | 2               | 1               | -               | -               | -               | -               | -                | -                | 3                | -           |
| C511.4              | 3               | 2               | 3               | 2               | 1               | -               | -               | -               | -               | -                | -                | 3                | -           |
| C511.5              | 3               | 3               | 2               | 2               | 1               | -               | -               | -               | -               | -                | -                | 3                | -           |

1-low,2-medium,3-high,'-'-nocorrelation

| Course Code                                                                                                                                                                                                                                                                                                                                            | Course Name                                                                                                                         | Category               | Hours/Week                |   |   | C    |      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|------|
|                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                     |                        | L                         | T | P |      |      |
| 24AM512                                                                                                                                                                                                                                                                                                                                                | KNOWLEDGE ENGINEERING                                                                                                               | PE                     | 3                         | 0 | 0 | 3    |      |
| Regulation                                                                                                                                                                                                                                                                                                                                             | Nature of the Course                                                                                                                | Semester               | Data Book/Codes/Standards |   |   |      |      |
| 24                                                                                                                                                                                                                                                                                                                                                     | THEORY                                                                                                                              | -                      |                           |   |   |      |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                |                                                                                                                                     | Co-requisite Course(s) |                           |   |   |      |      |
| Data Structures and Algorithms                                                                                                                                                                                                                                                                                                                         |                                                                                                                                     | -                      |                           |   |   |      |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                     |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                                                      | To understand the basics of Knowledge Engineering.                                                                                  |                        |                           |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                                                      | To discuss methodologies and modeling for Agent Design and Development.                                                             |                        |                           |   |   |      |      |
| 3                                                                                                                                                                                                                                                                                                                                                      | To design and develop ontologies.                                                                                                   |                        |                           |   |   |      |      |
| 4                                                                                                                                                                                                                                                                                                                                                      | To apply reasoning with ontologies and rules.                                                                                       |                        |                           |   |   |      |      |
| 5                                                                                                                                                                                                                                                                                                                                                      | To understand learning and rule learning                                                                                            |                        |                           |   |   |      |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                     |                        |                           |   |   |      |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                |                                                                                                                                     |                        |                           |   |   |      |      |
| C512.1                                                                                                                                                                                                                                                                                                                                                 | Understand the basics of Knowledge Engineering.                                                                                     |                        |                           |   |   | [U]  |      |
| C512.2                                                                                                                                                                                                                                                                                                                                                 | Apply methodologies and modelling for Agent Design and Development.                                                                 |                        |                           |   |   | [AP] |      |
| C512.3                                                                                                                                                                                                                                                                                                                                                 | Design and develop ontologies                                                                                                       |                        |                           |   |   | [AP] |      |
| C512.4                                                                                                                                                                                                                                                                                                                                                 | Apply reasoning with ontologies and rule                                                                                            |                        |                           |   |   | [AP] |      |
| C512.5                                                                                                                                                                                                                                                                                                                                                 | Understand learning and rule learning.                                                                                              |                        |                           |   |   | [U]  |      |
| Course Contents                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                     |                        |                           |   |   |      |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                 | REASONING UNDER UNCERTAINTY                                                                                                         |                        |                           |   |   | C01  | 9Hrs |
| Introduction-Abductive reasoning-Probabilistic reasoning:Enumerative Probabilities-Subjective Bayesian view-Belief Functions-Baconian Probability-Fuzzy Probability-Uncertainty methods-Evidence-based reasoning - Intelligent Agent - Mixed-Initiative Reasoning - Knowledge Engineering                                                              |                                                                                                                                     |                        |                           |   |   |      |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                 | METHODOLOGY AND MODELING                                                                                                            |                        |                           |   |   | C02  | 9Hrs |
| Conventional Design and Development -Development tools and Reusable Ontologies-Agent Design and Development using Learning Technology-Problem Solving through Analysis and Synthesis-Inquiry-driven Analysis and Synthesis-Evidence-based Assessment- Believability Assessment -Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios |                                                                                                                                     |                        |                           |   |   |      |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                 | ONTOLOGIES-DESIGN AND DEVELOPMENT                                                                                                   |                        |                           |   |   | C03  | 9Hrs |
| Concepts and Instances-Generalization Hierarchies-Object Features-Defining Features-Representation-Transitivity - Inheritance-Concepts as Feature Values -Ontology Matching.Design and Development Methodologies-Steps in Ontology Development-Domain Understanding and Concept Elicitation-Modelling-based Ontology Specification.                    |                                                                                                                                     |                        |                           |   |   |      |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                 | REASONING WITH ONTOLOGIES AND RULES                                                                                                 |                        |                           |   |   | C04  | 9Hrs |
| Production System Architecture-Complex Ontology-based Concepts-Reduction and Synthesis rules and the Inference Engine - Evidence-based hypothesis analysis - Rule and Ontology Matching-Partially Learned Knowledge - Reasoning with Partially Learned Knowledge                                                                                       |                                                                                                                                     |                        |                           |   |   |      |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                 | LEARNING AND RULE LEARNING                                                                                                          |                        |                           |   |   | C05  | 9Hrs |
| Machine Learning -Concepts -Generalization and Specialization Rules- Types -Formal definition of Generalization.Modelling, Learning and Problem Solving-Rule learning and Refinement-Overview-Rule Generation and Analysis - Hypothesis Learning                                                                                                       |                                                                                                                                     |                        |                           |   |   |      |      |
| Total Hours                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                     |                        |                           |   |   | 45   |      |
| Textbooks:                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                     |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                                                      | Artificial Intelligence: A Modern Approach, Stuart Russell, Peter Norvig, Pearson, Fourth Edition, 2020.                            |                        |                           |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                                                      | Knowledge Graphs, Aidan Hogan, et al., Morgan & Claypool Publishers, First Edition, 2022.                                           |                        |                           |   |   |      |      |
| Reference Books:                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                     |                        |                           |   |   |      |      |
| 1                                                                                                                                                                                                                                                                                                                                                      | Semantic Web for the Working Ontologist, Dean Allemang, James Hendler, Association for Computing Machinery, Third Edition, 2020.    |                        |                           |   |   |      |      |
| 2                                                                                                                                                                                                                                                                                                                                                      | Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.                                                          |                        |                           |   |   |      |      |
| 3                                                                                                                                                                                                                                                                                                                                                      | John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000. |                        |                           |   |   |      |      |
| Web References:                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                     |                        |                           |   |   |      |      |

|   |                                                                                                                                                                                                                   |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <a href="https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_expert_systems.htm">https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_expert_systems.htm</a> |
| 2 | <a href="https://www.w3.org/standards/semanticweb/ontology">https://www.w3.org/standards/semanticweb/ontology</a>                                                                                                 |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      |            |            |                          |
| Understand                                                  | 60                    |                | 40                   |            |            |                          |
| Apply                                                       | 40                    | 100            | 60                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/ POs | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PS01 | PS02 |
|----------|------|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|------|------|
| C512.1   | 3    | 2   | -   | -   | -   | -   | -   | -   | -   | -     | -     | 2    | -    |
| C512.2   | 2    | 3   | 3   | 2   | 3   | -   | -   | -   | -   | -     | -     | 3    | 2    |
| C512.3   | 2    | 3   | 3   | 2   | 3   | -   | -   | -   | -   | -     | -     | 3    | 2    |
| C512.4   | 2    | 3   | 2   | 3   | 2   | -   | -   | -   | -   | -     | -     | 3    | 2    |
| C512.5   | 2    | 2   | -   | 2   | 2   | -   | -   | -   | -   | -     | -     | 2    | 2    |

1-low, 2-medium, 3-high, '-'-no correlation

## OPEN ELECTIVES

### Open Elective Courses offered by Computer Science and Engineering (AIML) to other Departments

| S No. | Course Code | Course Title                          | L/T/P | Contact hrs./Wk. | Credits | Cat. |
|-------|-------------|---------------------------------------|-------|------------------|---------|------|
| 1.    | 24OE606     | Fundamentals of Computer Vision       | 3/0/0 | 3                | 3       | OE   |
| 2.    | 24OE607     | Machine Learning and its Applications | 3/0/0 | 3                | 3       | OE   |
| 3.    | 24OE608     | Deep Learning Techniques              | 3/0/0 | 3                | 3       | OE   |
| 4.    | 24OE609     | Language engineering                  | 3/0/0 | 3                | 3       | OE   |
| 5.    | 24OE610     | Neural Networks                       | 3/0/0 | 3                | 3       | OE   |

| CourseCode                                                                                                                                                                                                                                                   | CourseName                                                                                | Category              | Hours/Week               |   |   | C    |      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|---|------|------|
|                                                                                                                                                                                                                                                              |                                                                                           |                       | L                        | T | P |      |      |
| 24OE606                                                                                                                                                                                                                                                      | FUNDAMENTALSOFCOMPUTER VISION                                                             | OE                    | 3                        | 0 | 0 | 3    |      |
| Regulation                                                                                                                                                                                                                                                   | NatureoftheCourse                                                                         | Semester              | DataBook/Codes/Standards |   |   |      |      |
| 2024                                                                                                                                                                                                                                                         | Theory                                                                                    | VI                    | -                        |   |   |      |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                       |                                                                                           | Co-requisiteCourse(s) |                          |   |   |      |      |
| Programming in C, Probability andStatistics                                                                                                                                                                                                                  |                                                                                           | -                     |                          |   |   |      |      |
| CourseObjectives                                                                                                                                                                                                                                             |                                                                                           |                       |                          |   |   |      |      |
| 1                                                                                                                                                                                                                                                            | To understand the fundamental concepts related to Image formationandprocessing.           |                       |                          |   |   |      |      |
| 2                                                                                                                                                                                                                                                            | To learn feature detection, matching and detection                                        |                       |                          |   |   |      |      |
| 3                                                                                                                                                                                                                                                            | To become familiar with feature-based alignment and motion estimation                     |                       |                          |   |   |      |      |
| 4                                                                                                                                                                                                                                                            | To develop skills on3Dreconstruction                                                      |                       |                          |   |   |      |      |
| 5                                                                                                                                                                                                                                                            | To understand image-based rendering and recognition                                       |                       |                          |   |   |      |      |
| CourseOutcomes                                                                                                                                                                                                                                               |                                                                                           |                       |                          |   |   |      |      |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                               |                                                                                           |                       |                          |   |   |      |      |
| C606.1                                                                                                                                                                                                                                                       | To understand basic knowledge, theories and methods in image processingandcomputervision. |                       |                          |   |   | [U]  |      |
| C606.2                                                                                                                                                                                                                                                       | To implement basic and some advanced image processing techniquesinOpenCV.                 |                       |                          |   |   | [AP] |      |
| C606.3                                                                                                                                                                                                                                                       | To apply 2D feature- based image alignment, segmentationandmotionestimations.             |                       |                          |   |   | [AP] |      |
| C606.4                                                                                                                                                                                                                                                       | To apply3D image reconstruction techniques                                                |                       |                          |   |   | [AP] |      |
| C606.5                                                                                                                                                                                                                                                       | To design and develop innovative image processing andcomputer visionapplications.         |                       |                          |   |   | [AP] |      |
| CourseContents                                                                                                                                                                                                                                               |                                                                                           |                       |                          |   |   |      |      |
| Unit-1                                                                                                                                                                                                                                                       | INTRODUCTIONTOIMAGEFORMATIONANDPROCESSING                                                 |                       |                          |   |   | CO1  | 9Hrs |
| ComputerVision - Geometric primitives and transformations -Photometricimageformation-The digitalcamera- Point operators - Linear filtering-Moreneighborhoodoperators-Fourier transforms-Pyramidsandwavelets-Geometric transformations - Global optimization. |                                                                                           |                       |                          |   |   |      |      |
| Unit-2                                                                                                                                                                                                                                                       | FEATUREDETECTION,MATCHINGANDSEGMENTATION                                                  |                       |                          |   |   | CO2  | 9Hrs |

|                                                                                                                                                                                                                                                                                                |                                                                                                                                           |     |      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-----|------|
| Pointsandpatches-Edges-Lines-Segmentation-Activecontours-Splitandmerge-Meanshiftandmodefinding - Normalized cuts - Graphcuts andenergy-basedmethods.                                                                                                                                           |                                                                                                                                           |     |      |
| Unit-3                                                                                                                                                                                                                                                                                         | FEATURE-BASEDALIGNMENT&MOTIONESTIMATION                                                                                                   | C03 | 9Hrs |
| 2Dand3D feature-based alignment- Poseestimation -Geometric intrinsiccalibration - Triangulation-Two-frame structure from motion - Factorization - Bundle adjustment - Constrainedstructureandmotion-Translational alignment - Parametric motion -Spline-basedmotion-Opticalflow-Layeredmotion. |                                                                                                                                           |     |      |
| Unit-4                                                                                                                                                                                                                                                                                         | 3DRECONSTRUCTION                                                                                                                          | C04 | 9Hrs |
| Shape from X - Activerangefinding -Surface representations - Point-basedrepresentations- Volumetricrepresentations - Model-based reconstruction - Recovering texturemapsandalbedosos.                                                                                                          |                                                                                                                                           |     |      |
| Unit-5                                                                                                                                                                                                                                                                                         | IMAGE-BASEDRENDERINGANDRECOGNITION                                                                                                        | C05 | 9Hrs |
| View interpolation Layereddepthimages-LightfieldsandLumigraphs-Environmentmattes-Video-basedrendering- Objectdtetection-Facerecognition-Instancerecognition-Categoryrecognition-Contextand sceneunderstanding- Recognition databases and test sets.                                            |                                                                                                                                           |     |      |
| TotalHours                                                                                                                                                                                                                                                                                     |                                                                                                                                           |     | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                     |                                                                                                                                           |     |      |
| 1                                                                                                                                                                                                                                                                                              | D. A.Forsyth, J.Ponce, <i>ComputerVision:AModernApproach</i> ,2ndEdition,PearsonIndia,LatestReprint 2025.                                 |     |      |
| 2                                                                                                                                                                                                                                                                                              | Richard Szeliski, <i>ComputerVision:AlgorithmsandApplications</i> , 2ndEdition,Springer,2022.                                             |     |      |
| ReferenceBooks:                                                                                                                                                                                                                                                                                |                                                                                                                                           |     |      |
| 1                                                                                                                                                                                                                                                                                              | Richard Hartley and Andrew Zisserman, <i>Multiple View GeometryinComputer Vision</i> ,SecondEdition, Cambridge University Press,March2004 |     |      |
| 2                                                                                                                                                                                                                                                                                              | Christopher M. Bishop; <i>Pattern RecognitionandMachineLearning</i> ,Springer,2006                                                        |     |      |
| WebReferences:                                                                                                                                                                                                                                                                                 |                                                                                                                                           |     |      |

|   |                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------|
| 1 | <a href="https://archive.nptel.ac.in/courses/106/105/106105216/">https://archive.nptel.ac.in/courses/106/105/106105216/</a> |
| 2 | <a href="https://opencv.org/opencv-free-course/">https://opencv.org/opencv-free-course/</a>                                 |

| Assessment based on Continuous and End Semester Examination |                       |                  |                        |            |            |                          |
|-------------------------------------------------------------|-----------------------|------------------|------------------------|------------|------------|--------------------------|
| BLOOMS<br>TAXONOMY<br>LEVEL                                 | CONTINUOUS ASSESSMENT |                  |                        | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1<br>(6Marks)      | CIA2<br>(6Marks) | Model Exam<br>(8Marks) | (10Marks)  | (10Marks)  | (60Marks)                |
| Remember                                                    |                       |                  |                        | 10         | 10         |                          |
| Understand                                                  | 20                    | 20               | 20                     |            |            |                          |
| Apply                                                       | 80                    | 80               | 80                     |            |            |                          |
| Analyze                                                     |                       |                  |                        |            |            |                          |
| Evaluate                                                    |                       |                  |                        |            |            |                          |
| Create                                                      |                       |                  |                        |            |            |                          |
| <b>Total<br/>(100Marks)</b>                                 | <b>6</b>              | <b>6</b>         | <b>8</b>               | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C606.1      | 3    | 2    | -    | -    | 2    | -    | -    | -    | -    | -     | 2     | 2     | -     |
| C606.2      | 3    | 3    | 2    | 2    | 3    | -    | -    | -    | -    | -     | 2     | 3     | 2     |
| C606.3      | 3    | 2    | 2    | 2    | 3    | -    | -    | -    | -    | -     | 2     | 3     | 2     |
| C606.4      | 3    | 3    | 3    | 3    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 2     |
| C606.5      | 3    | 3    | 2    | 3    | 3    | 2    | 2    | 2    | 2    | -     | 3     | 3     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

Prepared by Approved by

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                     | CourseName                                                                                          | Category              | Hours/Week               |   |   | C  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|---|----|
|                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                     |                       | L                        | T | P |    |
| 240E607                                                                                                                                                                                                                                                                                                                                                                                                         | Machine Learning and its Applications                                                               | OE                    | 3                        | 0 | 0 | 3  |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                      | NatureoftheCourse                                                                                   | Semester              | DataBook/Codes/Standards |   |   |    |
| R24                                                                                                                                                                                                                                                                                                                                                                                                             | THEORY                                                                                              |                       | -----                    |   |   |    |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                     | Co-requisiteCourse(s) |                          |   |   |    |
| Nil                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                     | -                     |                          |   |   |    |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                     |                       |                          |   |   |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                               | To understand the basic concepts of machine learning.                                               |                       |                          |   |   |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                                               | To understand and build supervised learning models.                                                 |                       |                          |   |   |    |
| 3                                                                                                                                                                                                                                                                                                                                                                                                               | To understand and build unsupervised learning models.                                               |                       |                          |   |   |    |
| 4                                                                                                                                                                                                                                                                                                                                                                                                               | To design the algorithms based on corresponding metrics identified.                                 |                       |                          |   |   |    |
| 5                                                                                                                                                                                                                                                                                                                                                                                                               | To make use of classification algorithms, build the machine learning experiments.                   |                       |                          |   |   |    |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                     |                       |                          |   |   |    |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                                                                                                   |                                                                                                     |                       |                          |   |   |    |
| C607.1                                                                                                                                                                                                                                                                                                                                                                                                          | Understand the fundamental concepts and applications of machine learning.                           |                       |                          |   |   | U  |
| C607.2                                                                                                                                                                                                                                                                                                                                                                                                          | Apply preprocessing techniques and appropriate machine learning algorithms to real- world problems. |                       |                          |   |   | AP |
| C607.3                                                                                                                                                                                                                                                                                                                                                                                                          | Apply supervised learning algorithms and evaluate model performance.                                |                       |                          |   |   | AP |
| C607.4                                                                                                                                                                                                                                                                                                                                                                                                          | Implement ensemble and unsupervised learning techniques.                                            |                       |                          |   |   | AP |
| C607.5                                                                                                                                                                                                                                                                                                                                                                                                          | Design, evaluate, and compare machine learning experiments using appropriate statistical tools.     |                       |                          |   |   | AP |
| CourseContents                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                     |                       |                          |   |   |    |
| Unit -1                                                                                                                                                                                                                                                                                                                                                                                                         | INTRODUCTION TO MACHINE LEARNING                                                                    |                       |                          |   |   | 9  |
| Introduction to Machine Learning and its importance, Types of Machine Learning: Supervised, Unsupervised, and Reinforcement Learning, Basic concepts: features, labels, training data, etc., Popular Machine Learning algorithms: Linear Regression, Logistic Regression, Decision Trees, kNearest Neighbors, etc., Evaluation metrics for Machine Learning models: accuracy, precision, recall, F1-score, etc. |                                                                                                     |                       |                          |   |   |    |
| Unit - 2                                                                                                                                                                                                                                                                                                                                                                                                        | MACHINE LEARNING TECHNIQUES                                                                         |                       |                          |   |   | 9  |
| Machine Learning Techniques Data preprocessing techniques: handling missing data, feature scaling, feature encoding, etc., Model selection and hyperparameter tuning, Cross-validation techniques, Ensemble methods: Bagging, Boosting, Random Forests, etc., Introduction to deep learning and neural networks                                                                                                 |                                                                                                     |                       |                          |   |   |    |
| Unit - 3                                                                                                                                                                                                                                                                                                                                                                                                        | SUPERVISED LEARNING                                                                                 |                       |                          |   |   | 9  |
| Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function - Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model - Naive Bayes, Maximum margin classifier - Support vector machine, Decision Tree, Random Forests.                      |                                                                                                     |                       |                          |   |   |    |
| Unit - 4                                                                                                                                                                                                                                                                                                                                                                                                        | APPLICATIONS OF MACHINE LEARNING                                                                    |                       |                          |   |   | 9  |
| Ensemble learning applications, Voting technique, Bagging method, Boosting method, Stacking approach, Recommendation systems, K-means clustering for segmentation, KNN for classification, Anomaly detection.                                                                                                                                                                                                   |                                                                                                     |                       |                          |   |   |    |
| Unit -5                                                                                                                                                                                                                                                                                                                                                                                                         | MACHINE LEARNING PROJECT DESIGN AND ANALYSIS                                                        |                       |                          |   |   | 9  |
| Problem definition, Data collection, Data preprocessing, Model training (classification), Model training (regression), Model evaluation metrics, Model comparison, Model deployment basics, Ethical issues and challenges in real-world machine learning applications.                                                                                                                                          |                                                                                                     |                       |                          |   |   |    |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                     |                       |                          |   |   | 45 |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                     |                       |                          |   |   |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                               | Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.                |                       |                          |   |   |    |

|                        |                                                                                                                                                                         |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2                      | Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "SecondEdition",CRCPress,2022.                                                                         |
| <b>ReferenceBooks:</b> |                                                                                                                                                                         |
| 1                      | Christopher M. Bishop, "Pattern Recognition and Machine Learning",Springer, 2006.                                                                                       |
| 2                      | Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997.                                                                                                        |
| 3                      | MehryarMohri, AfshinRostamizadeh, AmeetTalwalkar,"FoundationsofMachineLearning",Second Edition, MIT Press, 2018.                                                        |
| 4                      | Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2016                                                                                         |
| 5                      | SebastainRaschka,VahidMirjalili , "PythonMachineLearning",Packtpublishing 3rdEdition,2019.                                                                              |
| <b>WebReferences:</b>  |                                                                                                                                                                         |
| 1                      | <a href="https://www.coursera.org/lecture/python-machine-learning/introduction-4f2So2">https://www.coursera.org/lecture/python-machine-learning/introduction-4f2So2</a> |
| 2                      | <a href="https://nptel.ac.in/courses/106/106/106106139/">https://nptel.ac.in/courses/106/106/106106139/</a>                                                             |

**AssessmentbasedonContinuousandEndSemesterExamination**

| Bloom'sLevel           | ContinuousAssessment |                  |                       | Assignme<br>nt | Attendan<br>ce | EndSemester<br>Examination |
|------------------------|----------------------|------------------|-----------------------|----------------|----------------|----------------------------|
|                        | CIA1<br>(6Marks)     | CIA2<br>(6Marks) | ModelExam<br>(8Marks) |                |                |                            |
| Remember               |                      |                  |                       | (10<br>Marks)  | (10<br>Marks)  | (60Marks)                  |
| Understand             | 80%                  | 20%              | 20%                   |                |                |                            |
| Apply                  | 20%                  | 80%              | 80%                   |                |                |                            |
| Analyze                |                      |                  |                       |                |                |                            |
| Evaluate               |                      |                  |                       |                |                |                            |
| Create                 |                      |                  |                       |                |                |                            |
| <b>Total(100Marks)</b> | <b>6</b>             | <b>6</b>         | <b>8</b>              | <b>10</b>      | <b>10</b>      | <b>60</b>                  |

- CIA1, CIA 2 and ModelExam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | P<br>01 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO1<br>0 | PO1<br>1 | PS0<br>1 | PS0<br>2 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|
| C607.1      | 3       | 2       | -       | -       | 2       | -       | -       | -       | -       | -        | 1        | -        | 3        |
| C607.2      | 3       | 3       | 2       | 2       | 3       | -       | -       | -       | -       | -        | 2        | -        | 3        |
| C607.3      | 3       | 3       | 3       | 2       | 3       | -       | -       | -       | -       | -        | 2        | -        | 3        |
| C607.4      | 3       | 3       | 3       | 3       | 3       | -       | -       | -       | -       | -        | 2        | -        | 3        |
| C607.5      | 3       | 3       | 3       | 3       | 3       | -       | -       | -       | -       | -        | 3        | -        | 3        |

3 - Strong 2 - Moderate 1- Weak -- no correlation

Prepared by Approved by

| Course Code                                                                                                                                                                                                                                                                                                                                             | CourseName                                                                      | Category                | Hours/Week               |   |     | C  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------|--------------------------|---|-----|----|
|                                                                                                                                                                                                                                                                                                                                                         |                                                                                 |                         | L                        | T | P   |    |
| 240E608                                                                                                                                                                                                                                                                                                                                                 | Deep Learning Techniques                                                        | OE                      | 3                        | 0 | 0   | 3  |
| Regulation                                                                                                                                                                                                                                                                                                                                              | NatureoftheCourse                                                               | Semester                | DataBook/Codes/Standards |   |     |    |
| 2024                                                                                                                                                                                                                                                                                                                                                    | Theory                                                                          | V                       | -                        |   |     |    |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                  |                                                                                 | Co-requisiteCourse(s)   |                          |   |     |    |
| Fundamentals of Machine Learning                                                                                                                                                                                                                                                                                                                        |                                                                                 | Artificial Intelligence |                          |   |     |    |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                        |                                                                                 |                         |                          |   |     |    |
| 1                                                                                                                                                                                                                                                                                                                                                       | To understand principles of deep neural networks.                               |                         |                          |   |     |    |
| 2                                                                                                                                                                                                                                                                                                                                                       | To understand CNN architectures of deep neural networks.                        |                         |                          |   |     |    |
| 3                                                                                                                                                                                                                                                                                                                                                       | To understand RNN architectures of deep neural networks.                        |                         |                          |   |     |    |
| 4                                                                                                                                                                                                                                                                                                                                                       | To comprehend advanced deep learning models.                                    |                         |                          |   |     |    |
| 5                                                                                                                                                                                                                                                                                                                                                       | To learn the evaluation metrics for deep learning models.                       |                         |                          |   |     |    |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                          |                                                                                 |                         |                          |   |     |    |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                                                                          |                                                                                 |                         |                          |   |     |    |
| C608.1                                                                                                                                                                                                                                                                                                                                                  | Understand the basics in deep neural networks.                                  |                         |                          |   |     | U  |
| C608.2                                                                                                                                                                                                                                                                                                                                                  | Apply Convolution Neural Network for image processing.                          |                         |                          |   |     | AP |
| C608.3                                                                                                                                                                                                                                                                                                                                                  | Apply Recurrent Neural Network and its variants for textanalysis.               |                         |                          |   |     | AP |
| C608.4                                                                                                                                                                                                                                                                                                                                                  | Demonstrate the model evaluation for various applications.                      |                         |                          |   |     | AP |
| C608.5                                                                                                                                                                                                                                                                                                                                                  | Apply autoencoders and generative models for suitable applications.             |                         |                          |   |     | AP |
| CourseContents                                                                                                                                                                                                                                                                                                                                          |                                                                                 |                         |                          |   |     |    |
| Unit-1                                                                                                                                                                                                                                                                                                                                                  | DEEPNETWORKSBASICS                                                              |                         |                          |   | C01 | 10 |
| LinearAlgebra:Scalars-- Vectors -- Matrices and tensors; ProbabilityDistributions--Gradient-basedOptimization-MachineLearningBasics:Capacity-- Overfitting and underfitting -- Hyperparametersand validation sets -- Estimators --Bias and variance--Stochasticgradientdescent--DeepNetworks:Deep feedforward networks; Regularization -- Optimization. |                                                                                 |                         |                          |   |     |    |
| Unit-2                                                                                                                                                                                                                                                                                                                                                  | CONVOLUTIONALNEURALNETWORKS                                                     |                         |                          |   | C02 | 10 |
| Convolution Operation --SparseInteractions--ParameterSharing--Equivariance--Pooling -- ConvolutionVariants:Strided--Tiled--Transposedanddilatedconvolutions;CNN Learning:Nonlinearity Functions -- Loss Functions--Regularization--Optimizers--GradientComputation.                                                                                     |                                                                                 |                         |                          |   |     |    |
| Unit-3                                                                                                                                                                                                                                                                                                                                                  | RECURRENTNEURALNETWORKS                                                         |                         |                          |   | C03 | 9  |
| UnfoldingGraphs -- RNN Design Patterns: Acceptor--Encoder--Transducer;GradientComputation-- SequenceModelingConditionedonContexts--BidirectionalRNN--SequencetoSequenceRNN-- DeepRecurrentNetworks--RecursiveNeuralNetworks--LongTermDependencies;LeakyUnits:Skip connections and dropouts; Gated Architecture: LSTM.                                   |                                                                                 |                         |                          |   |     |    |
| Unit-4                                                                                                                                                                                                                                                                                                                                                  | MODELEVALUATION                                                                 |                         |                          |   | C04 | 8  |
| Performancemetrics--BaselineModels--Hyperparameters:ManualHyperparameter-- AutomaticHyperparameter -- Grid search --Random search--Debuggingstrategies.                                                                                                                                                                                                 |                                                                                 |                         |                          |   |     |    |
| Unit-5                                                                                                                                                                                                                                                                                                                                                  | AUTOENCODERSANDGENERATIVEMODELS                                                 |                         |                          |   | C05 | 8  |
| Autoencoders:Undercompleteautoencoders--Regularizedautoencoders-- Stochastic encoders anddecoders--Learningwithautoencoders;DeepGenerativeModels: Variational autoencoders-- Generative adversarial networks -DALL-E,DALL-E2 andIMAGEN                                                                                                                  |                                                                                 |                         |                          |   |     |    |
| TotalHours                                                                                                                                                                                                                                                                                                                                              |                                                                                 |                         |                          |   |     | 45 |
| Textbooks:                                                                                                                                                                                                                                                                                                                                              |                                                                                 |                         |                          |   |     |    |
| 1                                                                                                                                                                                                                                                                                                                                                       | Ian Goodfellow, Yoshua Bengio, Aaron Courville, ``DeepLearning'',MITPress,2018. |                         |                          |   |     |    |
| 2                                                                                                                                                                                                                                                                                                                                                       | Andrew Glassner, "Deep Learning: A Visual Approach". No StarchPress.2021.       |                         |                          |   |     |    |

|                         |                                                                                                                                                                                                                  |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3                       | Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, "A Guide to Convolutional Neural Networks for Computer Vision", Synthesis Lectures on Computer Vision, Morgan & Claypool publishers, 2018. |
| <b>Reference Books:</b> |                                                                                                                                                                                                                  |
| 1                       | Francois Chollet, "Deep Learning with Python", Manning Publications Co, 2018.                                                                                                                                    |
| 2                       | Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 2018.                                                                                                     |
| 3                       | Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2021.                                                                                                                   |
| 4                       | Yoav Goldberg, "Neural Network Methods for Natural Language Processing", Synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2020.                                                  |
| <b>Web References:</b>  |                                                                                                                                                                                                                  |
| 1                       | <a href="https://nptel.ac.in/courses/">https://nptel.ac.in/courses/</a>                                                                                                                                          |
| 2                       | <a href="https://aikosh.indiaai.gov.in/static/Deep+Learning+Ian+Goodfellow.pdf">https://aikosh.indiaai.gov.in/static/Deep+Learning+Ian+Goodfellow.pdf</a>                                                        |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 80                    | 20             | 20                   |            |            |                          |
| Apply                                                       | 20                    | 80             | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PS 01 | PS 02 |
|---------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C608.1  | 3    | 2    | 1    | -    | 1    | -    | -    | -    | -    | -     | -     | 2     | 1     |
| C608.2  | 3    | 3    | 2    | 2    | 3    | -    | -    | -    | -    | -     | 1     | 3     | 2     |
| C608.3  | 2    | 3    | 3    | 2    | 3    | -    | -    | -    | 1    | -     | 1     | 3     | 3     |
| C608.4  | 2    | 3    | 2    | 3    | 2    | -    | -    | -    | -    | -     | 1     | 2     | 2     |
| C608.5  | 1    | 2    | 3    | 2    | 3    | -    | -    | -    | 1    | 1     | 1     | 3     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

**PreparedbyApprovedby**

| Course Code                                                                                                                                                                                                                                                 | CourseName                                                         | Category                  | Hours /Week               | C |   |    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|---------------------------|---------------------------|---|---|----|
|                                                                                                                                                                                                                                                             |                                                                    |                           | L                         | T | P |    |
| 24OE609                                                                                                                                                                                                                                                     | Language engineering                                               | OE                        | 3                         | 0 | 2 | 4  |
| Regulation                                                                                                                                                                                                                                                  | NatureoftheCourse                                                  | Semester                  | Data Book/Codes/Standards |   |   |    |
| R24                                                                                                                                                                                                                                                         | Theory                                                             | 4                         | -----                     |   |   |    |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                      |                                                                    | Co-requisiteCourse(s)     |                           |   |   |    |
| Nil                                                                                                                                                                                                                                                         |                                                                    | NaturalLanguageprocessing |                           |   |   |    |
| CourseObjectives                                                                                                                                                                                                                                            |                                                                    |                           |                           |   |   |    |
| 1                                                                                                                                                                                                                                                           | Tounderstandthefundamentalsofnaturallanguageprocessing             |                           |                           |   |   |    |
| 2                                                                                                                                                                                                                                                           | To construct the word level analysis methods                       |                           |                           |   |   |    |
| 3                                                                                                                                                                                                                                                           | To identify word class methods and models                          |                           |                           |   |   |    |
| 4                                                                                                                                                                                                                                                           | To construct Context Free Grammar in syntacticanalysis             |                           |                           |   |   |    |
| 5                                                                                                                                                                                                                                                           | To develop parsing concepts in syntacticanalysis                   |                           |                           |   |   |    |
| CourseOutcomes<br>Uponcompletionofthecourse,studentsshallhaveabilityto                                                                                                                                                                                      |                                                                    |                           |                           |   |   |    |
| C609.1                                                                                                                                                                                                                                                      | Understand basic language features for the given text.             |                           |                           |   |   | U  |
| C609.2                                                                                                                                                                                                                                                      | Buildarulebasedsystemtotacklemorphology/syntaxofalanguage          |                           |                           |   |   | AP |
| C609.3                                                                                                                                                                                                                                                      | Build a rule based tagging and models for word level applications. |                           |                           |   |   | AP |
| C609.4                                                                                                                                                                                                                                                      | Apply different statistical approaches for CFGapplications.        |                           |                           |   |   | AP |
| C609.5                                                                                                                                                                                                                                                      | Build innovative parsing concepts to process natural language.     |                           |                           |   |   | AP |
| CourseContents                                                                                                                                                                                                                                              |                                                                    |                           |                           |   |   |    |
| Unit –1                                                                                                                                                                                                                                                     | INTRODUCTION                                                       |                           |                           |   |   | 9  |
| Origins andchallengesofNLP – Language Modeling:Grammar-based LM,StatisticalLM- RegularExpressions,Finite- State Automata – English Morphology, Transducers for lexiconand rules,Tokenization,DetectingandCorrecting Spelling Errors, Minimum Edit Distance. |                                                                    |                           |                           |   |   |    |
| Unit – 2                                                                                                                                                                                                                                                    | WORD LEVEL ANALYSIS                                                |                           |                           |   |   | 9  |
| UnsmoothedN-grams, EvaluatingN-grams, Smoothing, InterpolationandBackoff–WordClasses,Part-of-SpeechTagging.                                                                                                                                                 |                                                                    |                           |                           |   |   |    |
| Unit – 3                                                                                                                                                                                                                                                    | WORD LEVEL MODELS                                                  |                           |                           |   |   | 9  |
| Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markovand MaximumEntropy models.                                                                                                                                    |                                                                    |                           |                           |   |   |    |
| Unit – 4                                                                                                                                                                                                                                                    | SYNTACTIC ANALYSIS -Context-Free Grammars                          |                           |                           |   |   | 9  |

|                                                                                                                                                                                                 |                                                                                                                                                                                 |    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – DependencyGrammar.                                                                                      |                                                                                                                                                                                 |    |
| Unit – 5                                                                                                                                                                                        | SYNTACTIC ANALYSIS -Parsing concepts                                                                                                                                            | 9  |
| SyntacticParsing,Ambiguity,DynamicProgrammingparsing–Shallow85parsing–ProbabilisticCFG,Probabilistic CYK,Probabilistic Lexicalized CFGs - Feature structures, Unification offeature structures. |                                                                                                                                                                                 |    |
| TotalHours                                                                                                                                                                                      |                                                                                                                                                                                 | 45 |
| Textbooks:                                                                                                                                                                                      |                                                                                                                                                                                 |    |
| 1                                                                                                                                                                                               | Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introductionto NaturalLanguage Processing, Computational Linguistics and Speech, Pearson Publication, 2014. |    |
| 2                                                                                                                                                                                               | StevenBird,EwanKleinandEdwardLoper,—NaturalLanguageProcessingwithPython,FirstEdition,O'R eilly Media, 2009.                                                                     |    |
| ReferenceBooks:                                                                                                                                                                                 |                                                                                                                                                                                 |    |
| 1                                                                                                                                                                                               | Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.                                                                                  |    |
| 2                                                                                                                                                                                               | Richard M Reese, —Natural Language Processing with Java  , O'Reilly Media, 2015.                                                                                                |    |
| 4                                                                                                                                                                                               | TanveerSiddiqui,U.S.Tiwary,“NaturalLanguageProcessingandInformationRetrieval”,Oxford University Press, 2008.                                                                    |    |
| WebReferences:                                                                                                                                                                                  |                                                                                                                                                                                 |    |
| 1                                                                                                                                                                                               | https://onlinecourses.nptel.ac.in/noc23_cs45/preview                                                                                                                            |    |

#### Assessment based on Continuous and End Semester Examination

| Bloom's Level            | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|--------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
|                          | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                 |                       |                   |                         | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand               | 80%                   | 20%               | 20%                     |            |            |                          |
| Apply                    | 20%                   | 80%               | 80%                     |            |            |                          |
| Analyze                  |                       |                   |                         |            |            |                          |
| Evaluate                 |                       |                   |                         |            |            |                          |
| Create                   |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| C0s/<br>POs | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO1<br>0 | PO1<br>1 | PO1<br>2 | PS0<br>1 | PS0<br>2 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|
| C609.1      | 3       | 2       | 1       | 2       | 1       | -       | -       | -       | -       | 1        | -        | -        | -        | 2        |
| C609.2      | 3       | 3       | 2       | 2       | -       | -       | -       | -       | -       | 2        | -        | -        | -        | 2        |
| C609.3      | 3       | 3       | 2       | 3       | -       | -       | -       | -       | -       | 2        | -        | -        | -        | 2        |
| C609.4      | 3       | 3       | 2       | 2       | -       | -       | -       | -       | -       | 1        | -        | -        | -        | 2        |
| C609.5      | 3       | 3       | 3       | 3       | -       | -       | -       | -       | -       | 2        | -        | -        | -        | 2        |

3 -Strong 2 - Moderate 1- Weak - - no correlation

Prepared by Approved by

| Course Code                                                                                                                                                                                                                                                                                                                                 | CourseName                                                                                                                                                                                          | Category                | Hours/Week               |   |   | C    |       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|--------------------------|---|---|------|-------|
|                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                     |                         | L                        | T | P |      |       |
| 24OE610                                                                                                                                                                                                                                                                                                                                     | Neural Networks                                                                                                                                                                                     | OE                      | 3                        | 0 | 0 | 3    |       |
| Regulation                                                                                                                                                                                                                                                                                                                                  | NatureoftheCourse                                                                                                                                                                                   | Semester                | DataBook/Codes/Standards |   |   |      |       |
| 24                                                                                                                                                                                                                                                                                                                                          | THEORY                                                                                                                                                                                              | VI                      |                          |   |   |      |       |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                     | Co-requisiteCourse(s)   |                          |   |   |      |       |
| Programming Fundamentals                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                     | Artificial Intelligence |                          |   |   |      |       |
| CourseObjectives                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                     |                         |                          |   |   |      |       |
| 1                                                                                                                                                                                                                                                                                                                                           | Introduce the basic concepts ofbiologicalneuronsandartificialneuralnetworks.                                                                                                                        |                         |                          |   |   |      |       |
| 2                                                                                                                                                                                                                                                                                                                                           | Explain different neuralnetworkarchitecturesandlearningalgorithms.                                                                                                                                  |                         |                          |   |   |      |       |
| 3                                                                                                                                                                                                                                                                                                                                           | Provide knowledge of fuzzysets,fuzzylogic,andfuzzyreasoningsystems.                                                                                                                                 |                         |                          |   |   |      |       |
| 4                                                                                                                                                                                                                                                                                                                                           | Understand fuzzyinferencesystemsandfuzzycontrollersusedinindustrialapplications.                                                                                                                    |                         |                          |   |   |      |       |
| 5                                                                                                                                                                                                                                                                                                                                           | Explain the principles and applications ofgeneticalgorithmsforoptimizationproblems.                                                                                                                 |                         |                          |   |   |      |       |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                     |                         |                          |   |   |      |       |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                     |                         |                          |   |   |      |       |
| C610.1                                                                                                                                                                                                                                                                                                                                      | Explain the structure and working ofbiological and artificial neural networks.                                                                                                                      |                         |                          |   |   | [U]  |       |
| C610.2                                                                                                                                                                                                                                                                                                                                      | Apply perceptron learning and back propagation algorithms to neural network models.                                                                                                                 |                         |                          |   |   | [AP] |       |
| C610.3                                                                                                                                                                                                                                                                                                                                      | Understand fuzzy sets, fuzzy relations and operations infuzzylogic.                                                                                                                                 |                         |                          |   |   | [U]  |       |
| C610.4                                                                                                                                                                                                                                                                                                                                      | Design fuzzy inference systems and fuzzy controllers forreal-worldapplications.                                                                                                                     |                         |                          |   |   | [AP] |       |
| C610.5                                                                                                                                                                                                                                                                                                                                      | Apply genetic algorithms for optimization and problem solving                                                                                                                                       |                         |                          |   |   | [AP] |       |
| CourseContents                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                     |                         |                          |   |   |      |       |
| Unit-1                                                                                                                                                                                                                                                                                                                                      | Introduction&Architecture                                                                                                                                                                           |                         |                          |   |   | C01  | 9Hrs  |
| Neuron, nerve structure and synapse. Artificial neuron and its model.Activation functions. Neural networkarchitecture:singlelayerfeed forward networks, multilayer feed forward networks, recurrent networks. Variouslearning techniques: perceptron learning rule, convergence rule. Auto-associative memory andhetero-associative memory. |                                                                                                                                                                                                     |                         |                          |   |   |      |       |
| Unit-2                                                                                                                                                                                                                                                                                                                                      | BackPropagationNetworks                                                                                                                                                                             |                         |                          |   |   | C02  | 10Hrs |
| Architecture of neural networks. Perceptronmodeland solution.Singlelayerartificialneuralnetwork.Multilayer perceptron model. Back propagationlearningmethods. Effect of learning rule coefficient. Backpropagation algorithm. Factors affecting back propagation training. Applications ofback propagation networks.                        |                                                                                                                                                                                                     |                         |                          |   |   |      |       |
| Unit-3                                                                                                                                                                                                                                                                                                                                      | FuzzyLogic-I(Introduction)                                                                                                                                                                          |                         |                          |   |   | C03  | 8Hrs  |
| Basicconceptsof fuzzylogic.Fuzzy sets and crisp sets. Fuzzysset theoryandoperations.Propertiesof fuzzysets.Fuzzy relations and crisp relations. Fuzzy to crispconversion.                                                                                                                                                                   |                                                                                                                                                                                                     |                         |                          |   |   |      |       |
| Unit-4                                                                                                                                                                                                                                                                                                                                      | FuzzyLogic-II(MembershipFunctionsandRules)                                                                                                                                                          |                         |                          |   |   | C04  | 9Hrs  |
| Membershipfunctions.Inferenceinfuzzylogic.FuzzyIF-THENrules.Fuzzyimplicationsandfuzzyalgorithms.Fuzzification and defuzzification. Fuzzy controller. Industrialapplicationsof fuzzy logic.                                                                                                                                                  |                                                                                                                                                                                                     |                         |                          |   |   |      |       |
| Unit-5                                                                                                                                                                                                                                                                                                                                      | GeneticAlgorithms(GA)                                                                                                                                                                               |                         |                          |   |   | C05  | 9Hrs  |
| Basic concepts of genetic algorithms. Working principle of GA. Procedureof GA.Flowchart ofGA. Geneticrepresentation (encoding). Initialization andselection.Geneticoperators.Mutation.Generationalcycle.Applications ofgenetic algorithms.                                                                                                  |                                                                                                                                                                                                     |                         |                          |   |   |      |       |
| TotalHours                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                     |                         |                          |   |   | 45   |       |
| Textbooks:                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                     |                         |                          |   |   |      |       |
| 1                                                                                                                                                                                                                                                                                                                                           | Soft Computing and Machine Learning: AFuzzy andNeutrosophic Viewof Reality,Mohd AnasWajid, Aasim Zafar, Mohammad SaifWajid, Akib MohiUdDinKhanday,PronayaBhattacharya,CRCPress, First Edition,2025. |                         |                          |   |   |      |       |
| 2                                                                                                                                                                                                                                                                                                                                           | Artificial Neural Networks and Type-2 FuzzySet,SnehashishChakraverty, ArupKumarSahoo,Dhabaleswar Mohapatra, Elsevier, First Edition,2025.                                                           |                         |                          |   |   |      |       |
| ReferenceBooks:                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                     |                         |                          |   |   |      |       |
| 1                                                                                                                                                                                                                                                                                                                                           | New Horizons for Fuzzy LogicNeuralNetworks andMetaheuristics.OscarCastillo.PatriciaMelin.                                                                                                           |                         |                          |   |   |      |       |

|                       |                                                                                                                    |
|-----------------------|--------------------------------------------------------------------------------------------------------------------|
|                       | Springer, First Edition, 2024.                                                                                     |
| 2                     | Soft Computing in Interdisciplinary Sciences, S. Chakraverty, Springer, First Edition, 2022.                       |
| <b>WebReferences:</b> |                                                                                                                    |
| 1                     | NPTEL Course – Fuzzy Logic and Neural Networks <a href="https://nptel.ac.in">https://nptel.ac.in</a>               |
| 2                     | Stanford Online – Machine Learning Resources <a href="https://online.stanford.edu">https://online.stanford.edu</a> |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOMS TAXONOMY LEVEL                                       | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      |            |            |                          |
| Understand                                                  | 60                    | 40             | 40                   |            |            |                          |
| Apply                                                       | 40                    | 60             | 60                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PS01 | PS02 |
|-------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|------|------|
| C610.1      | 3    | 2   | 2   | 1   | 1   | 1   | 0   | 0   | 0   | 0     | 2     | 2    | 1    |
| C610.2      | 3    | 3   | 3   | 2   | 2   | 1   | 2   | 2   | 1   | 0     | 3     | 3    | 2    |
| C610.3      | 2    | 2   | 2   | 1   | 1   | 1   | 0   | 0   | 0   | 0     | 2     | 2    | 1    |
| C610.4      | 3    | 3   | 3   | 2   | 2   | 2   | 2   | 2   | 1   | 1     | 3     | 3    | 2    |
| C610.5      | 3    | 3   | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 1     | 3     | 3    | 3    |

1-low, 2-medium, 3-high, '-'-no correlation

Prepared by Approved by

### **Open Elective courses offered to CSE(AIML) by other Departments**

| <b>S No.</b> | <b>Course Code</b> | <b>Course Title</b>                               | <b>L/T/P</b> | <b>Contact hrs./Wk.</b> | <b>Credits</b> | <b>Cat.</b> |
|--------------|--------------------|---------------------------------------------------|--------------|-------------------------|----------------|-------------|
| 1.           | 24OE601            | Text Analytics                                    | 3/0/0        | 3                       | 3              | OE          |
| 2.           | 24OE602            | Introduction to Artificial Intelligence           | 3/0/0        | 3                       | 3              | OE          |
| 3.           | 24OE603            | Health Informatics                                | 3/0/0        | 3                       | 3              | OE          |
| 4.           | 24OE604            | Management Analytics                              | 3/0/0        | 3                       | 3              | OE          |
| 5.           | 24OE605            | Data Science Essentials                           | 3/0/0        | 3                       | 3              | OE          |
| 6.           | 24OE611            | Database Fundamentals                             | 3/0/0        | 3                       | 3              | OE          |
| 7.           | 24OE612            | Basics of Image Processing                        | 3/0/0        | 3                       | 3              | OE          |
| 8.           | 24OE613            | Agile Methodologies                               | 3/0/0        | 3                       | 3              | OE          |
| 9.           | 24OE614            | Web Technology Fundamentals                       | 3/0/0        | 3                       | 3              | OE          |
| 10.          | 24OE615            | App Development Fundamentals                      | 3/0/0        | 3                       | 3              | OE          |
| 11.          | 24OE616            | Introduction to Augmented Reality/Virtual Reality | 3/0/0        | 3                       | 3              | OE          |
| 12.          | 24OE617            | Software Engineering                              | 3/0/0        | 3                       | 3              | OE          |
| 13.          | 24OE618            | Foundation of Cloud Computing                     | 3/0/0        | 3                       | 3              | OE          |
| 14.          | 24OE619            | Java Programming                                  | 3/0/0        | 3                       | 3              | OE          |
| 15.          | 24OE620            | Blockchain Technology                             | 3/0/0        | 3                       | 3              | OE          |
| 16.          | 24OE621            | Introduction to VLSI design                       | 3/0/0        | 3                       | 3              | OE          |
| 17.          | 24OE622            | Communication Engineering                         | 3/0/0        | 3                       | 3              | OE          |
| 18.          | 24OE623            | Sensors and Actuators                             | 3/0/0        | 3                       | 3              | OE          |
| 19.          | 24OE624            | Embedded System                                   | 3/0/0        | 3                       | 3              | OE          |
| 20.          | 24OE625            | Introduction to Internet of Things                | 3/0/0        | 3                       | 3              | OE          |
| 21.          | 24OE626            | Industrial Automation with PLC and SCADA          | 3/0/0        | 3                       | 3              | OE          |
| 22.          | 24OE627            | Electric Vehicle Technology                       | 3/0/0        | 3                       | 3              | OE          |
| 23.          | 24OE628            | Energy Technology                                 | 3/0/0        | 3                       | 3              | OE          |
| 24.          | 24OE629            | Battery Management Systems                        | 3/0/0        | 3                       | 3              | OE          |
| 25.          | 24OE630            | Power Converters for Electrical Appliances        | 3/0/0        | 3                       | 3              | OE          |
| 26.          | 24OE631            | Foundation of Robotics                            | 3/0/0        | 3                       | 3              | OE          |

|     |         |                                          |       |   |   |    |
|-----|---------|------------------------------------------|-------|---|---|----|
| 27. | 240E632 | Basics of Drone Technology               | 3/0/0 | 3 | 3 | OE |
| 28  | 240E633 | Industrial Management                    | 3/0/0 | 3 | 3 | OE |
| 29. | 240E634 | Additive Manufacturing                   | 3/0/0 | 3 | 3 | OE |
| 30. | 240E635 | Introduction to Non- Destructive Testing | 3/0/0 | 3 | 3 | OE |
| 31. | 240E636 | Fundamentals of Operations Research      | 3/0/0 | 3 | 3 | OE |
| 32. | 240E637 | Organizational Behaviour                 | 3/0/0 | 3 | 3 | OE |
| 33. | 240E638 | Total Quality Management                 | 3/0/0 | 3 | 3 | OE |
| 34. | 240E639 | Intellectual Property Rights             | 3/0/0 | 3 | 3 | OE |
| 35. | 240E640 | Emotional Intelligence                   | 3/0/0 | 3 | 3 | OE |
| 36. | 240E641 | Algebra and Number Theory                | 3/0/0 | 3 | 3 | OE |
| 37. | 240E642 | Linear Algebra                           | 3/0/0 | 3 | 3 | OE |
| 38  | 240E643 | Advanced Engineering Chemistry           | 3/0/0 | 3 | 3 | OE |
| 39. | 240E644 | Nanotechnology and NLO Materials         | 3/0/0 | 3 | 3 | OE |
| 40. | 240E645 | English for Competitive Examinations     | 3/0/0 | 3 | 3 | OE |

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                     | Course Name                                                                                                                            | Category               | Hours/Week                |   |             | C    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-------------|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                        |                        | L                         | T | P           |      |
| 24OE601                                                                                                                                                                                                                                                                                                                                                                                                                         | TEXT ANALYTICS                                                                                                                         | OE                     | 3                         | 0 | 0           | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                      | Nature of the Course                                                                                                                   | Semester               | Data Book/Codes/Standards |   |             |      |
| R24                                                                                                                                                                                                                                                                                                                                                                                                                             | OPEN ELECTIVE                                                                                                                          | -                      | -                         |   |             |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                        | Co-requisite Course(s) |                           |   |             |      |
| -                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                        | -                      |                           |   |             |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                        |                        |                           |   |             |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                               | To understand the methods for keyword extraction from documents.                                                                       |                        |                           |   |             |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                               | To learn clustering methods for grouping of documents.                                                                                 |                        |                           |   |             |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                               | To explore the methods for classification of documents and E-mails.                                                                    |                        |                           |   |             |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                               | To explore text visualization techniques and anomaly detection.                                                                        |                        |                           |   |             |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                               | To learn about Events and trends in text streams                                                                                       |                        |                           |   |             |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                        |                        |                           |   |             |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                        |                        |                           |   |             |      |
| C601.1                                                                                                                                                                                                                                                                                                                                                                                                                          | Design text extraction techniques.                                                                                                     |                        |                           |   |             | [U]  |
| C601.2                                                                                                                                                                                                                                                                                                                                                                                                                          | Devise clustering techniques for text mining                                                                                           |                        |                           |   |             | [AP] |
| C601.3                                                                                                                                                                                                                                                                                                                                                                                                                          | Design classification techniques for text mining                                                                                       |                        |                           |   |             | [AP] |
| C601.4                                                                                                                                                                                                                                                                                                                                                                                                                          | Apply visualization techniques and perform anomaly & trend detection                                                                   |                        |                           |   |             | [AP] |
| C601.5                                                                                                                                                                                                                                                                                                                                                                                                                          | Perform Event operations in Text streams                                                                                               |                        |                           |   |             | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                        |                        |                           |   |             |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                          | TEXT EXTRACTION                                                                                                                        |                        |                           |   |             | 9    |
| Introduction-<br>Rapid automatic keyword extraction: candidate keywords, keyword scores, adjoining keywords, extracted keywords- Benchmark evaluation: precision and recall, efficiency, stoplist generation, Evaluation on new articles.                                                                                                                                                                                       |                                                                                                                                        |                        |                           |   |             |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                          | DOCUMENT CLUSTERING                                                                                                                    |                        |                           |   |             | 9    |
| Multilingual document clustering: Multilingual LSA, Tucker1 method, PARAFAC2 method, LSA with term alignments, LMSA, LMSA with term alignments; Constrained clustering with k-means type algorithms                                                                                                                                                                                                                             |                                                                                                                                        |                        |                           |   |             |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                          | CONTENT BASED CLASSIFICATION                                                                                                           |                        |                           |   |             | 9    |
| Classification algorithms for Document Classification, Content-based spam email classification, Utilizing nonnegative matrix factorization for email classification problems.                                                                                                                                                                                                                                                   |                                                                                                                                        |                        |                           |   |             |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                          | ANOMALY AND TREND DETECTION                                                                                                            |                        |                           |   |             | 9    |
| Text visualization techniques: Visualization in text analysis, Tag clouds, tag clouds, authorship and change tracking, Data Exploration and the search for novel patterns, sentiment tracking, visual analytics and Future Lens, scenario discovery. Adaptive threshold setting for novelty mining: Introduction, adaptive threshold for anomaly detection, Experimental study.                                                 |                                                                                                                                        |                        |                           |   |             |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                          | TEXT STREAMS                                                                                                                           |                        |                           |   |             | 9    |
| Events and trends in text streams: Introduction, Text streams, Feature extraction and data reduction, Event detection, Trend detection, Event and trend descriptions. Embedding semantics in LDA topic models: Introduction, vector space modeling, latent semantic analysis, probabilistic latent semantic analysis, Latent Dirichlet allocation, embedding external semantics from Wikipedia, data-driven semantic embedding. |                                                                                                                                        |                        |                           |   |             |      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                        |                        |                           |   | Total Hours | 45   |
| Reference Books:                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                        |                        |                           |   |             |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                               | Michael W. Berry & Jacob Kogan, "Text Mining Applications and Theory", Wiley publications, 2010                                        |                        |                           |   |             |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                               | Aggarwal, Charu C., and Cheng Xiang Zhai, eds., "Mining text data", Springer Science & Business Media, 2012.                           |                        |                           |   |             |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                               | Miner, Gary, et al., "Practical text mining and statistical analysis for non-structured text data applications", Academic Press, 2012. |                        |                           |   |             |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                               | Srivastava, Ashok N., and Mehran Sahami, "Text mining: Classification, clustering, and applications", Chapman and Hall/CRC, 2009.      |                        |                           |   |             |      |

|   |                                                                                                                                                               |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 | Buitelaar, Paul, Philipp Cimiano, and Bernardo Magnini, eds., "Ontology learning from text: methods, evaluation and applications", Vol. 123. IOS press, 2005. |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------|

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                   |                         | 100%       | 100%       | 100%                     |
| Understand                                                  | 80%                   |                   | 20%                     |            |            |                          |
| Apply                                                       | 20%                   | 100%              | 80%                     |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO1<br>0 | PO1<br>1 | PS0<br>1 | PS0<br>2 | PS03 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|------|
| C601.1      | 3       | 3       | 3       | 3       | 2       | -       | -       | -       | -       | -        | 3        | 3        | 3        | -    |
| C601.2      | 3       | 3       | 3       | 3       | 2       | -       | -       | -       | -       | -        | 3        | 3        | 3        | -    |
| C601.3      | 3       | 3       | 3       | 3       | 2       | -       | -       | -       | -       | -        | 3        | 3        | 3        | -    |
| C601.4      | 3       | 3       | 3       | 3       | 2       | -       | -       | -       | -       | -        | 3        | 3        | 3        | -    |
| C601.5      | 3       | 3       | 3       | 3       | 2       | -       | -       | -       | -       | -        | 3        | 3        | 3        | -    |

| Course Code                                                                                                                                                                                                                                                                                                                                                                | Course Name                                                                                                                                                                | Category               | Hours/Week                |   |   | C    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|
|                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                            |                        | L                         | T | P |      |
| 24OE602                                                                                                                                                                                                                                                                                                                                                                    | INTRODUCTION TO ARTIFICIAL INTELLIGENCE                                                                                                                                    | OE                     | 3                         | 0 | 0 | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                 | Nature of the Course                                                                                                                                                       | Semester               | Data Book/Codes/Standards |   |   |      |
| R24                                                                                                                                                                                                                                                                                                                                                                        | THEORY                                                                                                                                                                     | -                      | -----                     |   |   |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                            | Co-requisite Course(s) |                           |   |   |      |
| -                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                            | -                      |                           |   |   |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                            |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                                                          | To learn what Artificial Intelligence is, its history, and how intelligent agents work.                                                                                    |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                                                          | To understand how AI solves problems using different search methods.                                                                                                       |                        |                           |   |   |      |
| 3                                                                                                                                                                                                                                                                                                                                                                          | To study various search algorithms like breadth-first, depth-first, and others.                                                                                            |                        |                           |   |   |      |
| 4                                                                                                                                                                                                                                                                                                                                                                          | To learn how AI plays games and how it uses knowledge to make decisions.                                                                                                   |                        |                           |   |   |      |
| 5                                                                                                                                                                                                                                                                                                                                                                          | To understand how AI represents knowledge and reasons using logic and categories.                                                                                          |                        |                           |   |   |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                            |                        |                           |   |   |      |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                            |                        |                           |   |   |      |
| C0602.1                                                                                                                                                                                                                                                                                                                                                                    | Enumerate the history and foundations of Artificial Intelligence.                                                                                                          |                        |                           |   |   | [U]  |
| C0602.2                                                                                                                                                                                                                                                                                                                                                                    | Apply the basic principles of AI in problem solving. (Apply-L3).                                                                                                           |                        |                           |   |   | [AP] |
| C0602.3                                                                                                                                                                                                                                                                                                                                                                    | Illustrate the different searching algorithms to find and optimize the solution for the given problem.                                                                     |                        |                           |   |   | [AP] |
| C0602.4                                                                                                                                                                                                                                                                                                                                                                    | Illustrate the different gaming algorithms and identify the importance of knowledge representation in Artificial Intelligence.                                             |                        |                           |   |   | [AP] |
| C0602.5                                                                                                                                                                                                                                                                                                                                                                    | Describe the use of predicate logic to represent the knowledge in the AI domain.                                                                                           |                        |                           |   |   | [U]  |
| Course Contents                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit-I                                                                                                                                                                                                                                                                                                                                                                     | INTRODUCTION                                                                                                                                                               |                        |                           |   |   | 9    |
| What is AI?, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents.                                                                                                                           |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit-II                                                                                                                                                                                                                                                                                                                                                                    | PROBLEM SOLVING AND SEARCH ALGORITHMS                                                                                                                                      |                        |                           |   |   | 9    |
| Problem-Solving Agents, Example Problems, searching for Solutions, search algorithms terminologies, properties of search algorithms, types of search algorithms. Informed and Uninformed Search Strategies, Informed (Heuristic) Search Algorithms: Best first search, A* Algorithm, AO* Algorithm, and Local Search Algorithms. Searching with Non-deterministic Actions. |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit-III                                                                                                                                                                                                                                                                                                                                                                   | SEARCH ALGORITHMS: UNIFORMED/BLIND SEARCH ALGORITHMS                                                                                                                       |                        |                           |   |   | 9    |
| Breadth-first Search, Depth-first Search, Depth-limited Search, Iterative deepening depth-first search, Uniform cost search, Bidirectional Search.                                                                                                                                                                                                                         |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit-IV                                                                                                                                                                                                                                                                                                                                                                    | GAME PLAYING AND KNOWLEDGE-BASED AGENT                                                                                                                                     |                        |                           |   |   | 9    |
| Adversarial Search/ Game Playing: Introduction, Minimax algorithm, Alpha-Beta pruning. Knowledge-Based Agent: Architecture, Knowledge base Levels, Types, Knowledge Representation mappings, forward and backward chaining/Reasoning techniques of inference engine, Approaches of knowledge representation, issues in knowledge representation.                           |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit-V                                                                                                                                                                                                                                                                                                                                                                     | KNOWLEDGE REPRESENTATION TECHNIQUES                                                                                                                                        |                        |                           |   |   | 9    |
| Propositional Logic: A Very Simple Logic, Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, What is Reasoning? Types of Reasoning and Reasoning Systems for Categories, The Internet Shopping World.                                                                                                                              |                                                                                                                                                                            |                        |                           |   |   |      |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                            |                        |                           |   |   | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                            |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                                                          | Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd edition, Prentice Hall, 2009. Can also use 2nd Ed., Pearson Education International, 2003. |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                                                          | Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011                                                                                                     |                        |                           |   |   |      |
| 3                                                                                                                                                                                                                                                                                                                                                                          | Rich & Knight, Artificial Intelligence, second edition, Tata McGraw Hill.                                                                                                  |                        |                           |   |   |      |
| Reference Books:                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                            |                        |                           |   |   |      |

|                        |                                                                                                                               |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| 1                      | Nils Nilsson, "Artificial Intelligence: A New Synthesis", Morgan Kaufmann, 1998                                               |
| 2                      | David Poole, Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge Univ. Press, 2010.    |
| 3                      | Ronald Brachman, "Knowledge Representation and Reasoning", Morgan Kaufmann, 2004.                                             |
| 4                      | Frank van Harmelen, Vladimir Lifschitz, Bruce Porter (Eds), "Handbook of Knowledge Representation", Elsevier, 2008.           |
| 5                      | Ivan Bratko, "Prolog Programming for Artificial Intelligence", 4th Ed., Addison-Wesley, 2011.                                 |
| <b>Web References:</b> |                                                                                                                               |
| 1                      | <a href="https://onlinecourses.nptel.ac.in/noc24_cs08/preview">https://onlinecourses.nptel.ac.in/noc24_cs08/preview</a>       |
| 2                      | <a href="https://nptel.ac.in/domains/discipline/106?course=106_0">https://nptel.ac.in/domains/discipline/106?course=106_0</a> |

**Assessment based on Continuous and End Semester Examination**

| Bloom's Level            | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|--------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
|                          | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                 |                       |                   |                         | 100%       | 100%       | 100%                     |
| Understand               | 50%                   |                   | 40%                     |            |            |                          |
| Apply                    | 50%                   | 100%              | 60%                     |            |            |                          |
| Analyze                  |                       |                   |                         |            |            |                          |
| Evaluate                 |                       |                   |                         |            |            |                          |
| Create                   |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C602.1      | 3    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1     | 1     | 3     | 1     | 1     |
| C602.2      | 3    | 3    | 2    | 2    | 1    | 1    | 1    | 1    | 1    | 1     | 1     | 3     | 1     | 2     |
| C602.3      | 3    | 3    | 2    | 2    | 1    | 1    | 1    | 1    | 1    | 1     | 1     | 3     | 1     | 2     |
| C602.4      | 3    | 2    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1     | 1     | 3     | 1     | 1     |
| C602.5      | 3    | 2    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 1     | 1     | 1     | 1     | 2     |

| Course Code                                                                                                                                                                                                                 | Course Name                                                                                                               | Category               | Hours/Week                |   |   | C    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|
|                                                                                                                                                                                                                             |                                                                                                                           |                        | L                         | T | P |      |
| 24OE603                                                                                                                                                                                                                     | HEALTHINFORMATICS                                                                                                         | OE                     | 3                         | 0 | 0 | 3    |
| Regulation                                                                                                                                                                                                                  | Nature of the Course                                                                                                      | Semester               | Data Book/Codes/Standards |   |   |      |
| R24                                                                                                                                                                                                                         | THEORY                                                                                                                    | -                      | -----                     |   |   |      |
| Pre-requisite Course(s)                                                                                                                                                                                                     |                                                                                                                           | Co-requisite Course(s) |                           |   |   |      |
| ARTIFICIAL INTELLIGENCE, PYTHON PROGRAMMING, MACHINE LEARNING, DEEP LEARNING                                                                                                                                                |                                                                                                                           | -                      |                           |   |   |      |
| Course Objectives                                                                                                                                                                                                           |                                                                                                                           |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                           | To understand the health data formats, healthcare policy and standards.                                                   |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                           | To understand the significance and need of data analysis and data visualization.                                          |                        |                           |   |   |      |
| 3                                                                                                                                                                                                                           | To understand the health data management frameworks.                                                                      |                        |                           |   |   |      |
| 4                                                                                                                                                                                                                           | To apply the machine learning and deep learning algorithms in healthcare.                                                 |                        |                           |   |   |      |
| 5                                                                                                                                                                                                                           | To apply healthcare analytics for critical care applications.                                                             |                        |                           |   |   |      |
| Course Outcomes                                                                                                                                                                                                             |                                                                                                                           |                        |                           |   |   |      |
| Upon completion of the course, students will be able to                                                                                                                                                                     |                                                                                                                           |                        |                           |   |   |      |
| C603.1                                                                                                                                                                                                                      | Understand the basics of health data analysis.                                                                            |                        |                           |   |   | [U]  |
| C603.2                                                                                                                                                                                                                      | Apply the Machine Learning techniques for analysis.                                                                       |                        |                           |   |   | [AP] |
| C603.3                                                                                                                                                                                                                      | Apply various evaluation metrics on healthcare data.                                                                      |                        |                           |   |   | [AP] |
| C603.4                                                                                                                                                                                                                      | Implement python frameworks on healthcare data.                                                                           |                        |                           |   |   | [AP] |
| C603.5                                                                                                                                                                                                                      | Implement various healthcare management techniques.                                                                       |                        |                           |   |   | [AP] |
| Course Contents                                                                                                                                                                                                             |                                                                                                                           |                        |                           |   |   |      |
| Unit-I                                                                                                                                                                                                                      | INTRODUCTION TO HEALTHCARE ANALYSIS                                                                                       |                        |                           |   |   | 9    |
| Overview-History of Healthcare Analysis Parameters on medical care systems-Healthcare policy- Standardized code sets - Data Formats.                                                                                        |                                                                                                                           |                        |                           |   |   |      |
| Unit-II                                                                                                                                                                                                                     | ANALYTICS ON MACHINE LEARNING                                                                                             |                        |                           |   |   | 9    |
| Machine Learning Foundations: Tree Like reasoning , Probabilistic reasoning and Bayes Theorem, Weighted sum approach- Machine Learning Pipeline-Pre-processing-Visualization- Feature Selection - Training model parameter. |                                                                                                                           |                        |                           |   |   |      |
| Unit-III                                                                                                                                                                                                                    | EVALUATION METRICS                                                                                                        |                        |                           |   |   | 9    |
| Evaluation model: Sensitivity, Specificity, PPV, NPV, FPR, Accuracy, ROC, Precision Recall Curves, Value of target variables - Python: Variables and types, Data Structures and containers.                                 |                                                                                                                           |                        |                           |   |   |      |
| Unit-IV                                                                                                                                                                                                                     | PYTHON IN HEALTHCARE                                                                                                      |                        |                           |   |   | 9    |
| Pandas Data Frame: Operations -Scikit-Learn: Pre-processing, Feature Selection-IOT-Smart Sensors - Migration of Healthcare Relational database to NoSQL Cloud Database.                                                     |                                                                                                                           |                        |                           |   |   |      |
| Unit-V                                                                                                                                                                                                                      | HEALTHCARE MANAGEMENT                                                                                                     |                        |                           |   |   | 9    |
| Decision Support System-Matrix block Cipher System-Semantic Framework Analysis-Histogram bin Shifting and Rc6 Encryption - Clinical Prediction Models- Visual Analytics for Healthcare.                                     |                                                                                                                           |                        |                           |   |   |      |
| Total Hours                                                                                                                                                                                                                 |                                                                                                                           |                        |                           |   |   | 45   |
| Textbooks:                                                                                                                                                                                                                  |                                                                                                                           |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                           | Chandan K.Reddy, Charu C. Aggarwal, "Health Care data Analysis", First edition, CRC, 2015.                                |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                           | Hui Jang, Eva K.Lee, "HealthCare Analysis: From Data to Knowledge to Healthcare Improvement", First Edition, Wiley, 2016. |                        |                           |   |   |      |
| Reference Books:                                                                                                                                                                                                            |                                                                                                                           |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                           | Vikas Kumar, "Health Care Analysis Made Simple". Packt Publishing, 2018.                                                  |                        |                           |   |   |      |

|                       |                                                                                                                                             |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 2                     | Nilanjan Dey, Amira Ashour, Simon James Fong, Chintan Bhatl, "HealthCare Data Analysis and Management, First Edition, Academic Press, 2018. |
| 3                     | Kulkarni, Siarry, Singh, Abraham, Zhang, Zomaya, Baki, "Big Data Analytics in Health Care", Springer, 2020.                                 |
| 4                     | Deep Learning- Ian Goodfellow, Yoshua Benjio, Aaron Courville, The MIT Press.                                                               |
| <b>WebReferences:</b> |                                                                                                                                             |
| 1                     | <a href="https://onlinecourses.nptel.ac.in/noc22_hs40/preview">https://onlinecourses.nptel.ac.in/noc22_hs40/preview</a> .                   |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                   |                         | 100%       | 100%       | 100%                     |
| Understand                                                  | 40%                   | -                 | 20%                     |            |            |                          |
| Apply                                                       | 60%                   | 100%              | 80%                     |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    |                       |                   |                         | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PSO<br>2 | PSO<br>3 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|
| C603.1      | 3       | 2       | 2       | 1       | 1       | -       | -       | -       | -       | -        | -        | 3        | -        | 2        |
| C603.2      | 3       | 3       | 2       | 2       | 2       | -       | -       | -       | -       | -        | -        | 3        | -        | 2        |
| C603.3      | 3       | 3       | 2       | 2       | 2       | -       | -       | -       | -       | -        | -        | 3        | -        | 2        |
| C603.4      | 3       | 2       | 2       | 1       | 1       | -       | -       | -       | -       | -        | -        | 3        | -        | 1        |
| C603.5      | 3       | 2       | 3       | 1       | 1       | -       | -       | -       | -       | -        | -        | 3        | -        | 2        |

| CourseCode                                                                                                                                                                                     | CourseName                                                                                                                                                                 | Category              | Hours/Week               |   |   | C    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|---|------|
|                                                                                                                                                                                                |                                                                                                                                                                            |                       | L                        | T | P |      |
| 24OE604                                                                                                                                                                                        | MANAGEMENT ANALYTICS                                                                                                                                                       | HS                    | 3                        | 0 | 0 | 3    |
| Regulation<br>R24                                                                                                                                                                              | NatureoftheCourse<br>THEORY                                                                                                                                                | Semester              | DataBook/Codes/Standards |   |   |      |
| Pre-requisiteCourse(s)                                                                                                                                                                         |                                                                                                                                                                            | Co-requisiteCourse(s) |                          |   |   |      |
| CourseObjectives                                                                                                                                                                               |                                                                                                                                                                            |                       |                          |   |   |      |
| 1                                                                                                                                                                                              | ToexplaintherelationshipbetweenBAandorganizationaldecision-making.                                                                                                         |                       |                          |   |   |      |
| 2                                                                                                                                                                                              | ToanalyzeorganizationalstructuresforeffectiveBusinessAnalytics.                                                                                                            |                       |                          |   |   |      |
| 3                                                                                                                                                                                              | Toapplytheappropriateanalyticsandgeneratesolutions.                                                                                                                        |                       |                          |   |   |      |
| 4                                                                                                                                                                                              | Tomodelandanalysethebusinesssituationusinganalytics.                                                                                                                       |                       |                          |   |   |      |
| 5                                                                                                                                                                                              | Torecognizetheconceptsandtechniquesofprescriptiveanalytics                                                                                                                 |                       |                          |   |   |      |
| CourseOutcomes                                                                                                                                                                                 |                                                                                                                                                                            |                       |                          |   |   |      |
| Uponcompletionofthecourse,studentswillbeableto                                                                                                                                                 |                                                                                                                                                                            |                       |                          |   |   |      |
| C604.1                                                                                                                                                                                         | Understandthefundamentalconcepts,terminologies,processes,andimportanceofBusinessAnalyticsindecisionmaking.                                                                 |                       |                          |   |   | [U]  |
| C604.2                                                                                                                                                                                         | Demonstrate the management of BA personnel, data, and technology.                                                                                                          |                       |                          |   |   | [AP] |
| C604.3                                                                                                                                                                                         | Applydescriptiveanalyticstechniquestovisualize,explore,andsummarizethe data.                                                                                               |                       |                          |   |   | [AP] |
| C604.4                                                                                                                                                                                         | Applytheprinciplesofpredictiveanalytics, includinglogic-drivenanddata-driven models.                                                                                       |                       |                          |   |   | [AP] |
| C604.5                                                                                                                                                                                         | Implementtheapplicationofprescriptiveanalyticsindemonstratingbusiness performance improvement.                                                                             |                       |                          |   |   | [AP] |
| CourseContents                                                                                                                                                                                 |                                                                                                                                                                            |                       |                          |   |   |      |
| Unit-1                                                                                                                                                                                         | INTRODUCTIONTOBUSINESSANALYTICS(BA)                                                                                                                                        |                       |                          |   |   | 9    |
| BusinessAnalytics –Terminologies-Process-Importance-RelationshipwithOrganisationalDecision Making-Analytics in Decision Making-BA for Competitive Advantage.                                   |                                                                                                                                                                            |                       |                          |   |   |      |
| Unit-2                                                                                                                                                                                         | MANAGINGRESOURCESFORBUSINESSANALYTICS                                                                                                                                      |                       |                          |   |   | 9    |
| Managing BA Personnel-DataandTechnology-OrganisationalStructuresaligningBA- ManagingInformation policy-data quality and change in BA.                                                          |                                                                                                                                                                            |                       |                          |   |   |      |
| Unit-3                                                                                                                                                                                         | DESCRIPTIVEANALYTICS                                                                                                                                                       |                       |                          |   |   | 9    |
| Introduction to Descriptive analytics-VisualisingandExploringData-DescriptiveStatistics- SamplingandEstimation-ProbabilityDistributionforDescriptiveAnalytics- AnalysisofDescriptiveanalytics. |                                                                                                                                                                            |                       |                          |   |   |      |
| Unit-4                                                                                                                                                                                         | PREDICTIVEANALYTICS                                                                                                                                                        |                       |                          |   |   | 9    |
| IntroductiontoPredictiveanalytics-LogicandDataDrivenModels-PredictiveAnalysis-Modeling and procedure - Data Mining for Predictive analytics. Analysis of Predictive analytics.                 |                                                                                                                                                                            |                       |                          |   |   |      |
| Unit-5                                                                                                                                                                                         | PRESCRIPTIVEANALYTICS                                                                                                                                                      |                       |                          |   |   | 9    |
| Introduction to Prescriptive analytics - Prescriptive Modeling -NonLinearOptimisation- DemonstratingBusinessPerformancelImprovement.                                                           |                                                                                                                                                                            |                       |                          |   |   |      |
| TotalHours                                                                                                                                                                                     |                                                                                                                                                                            |                       |                          |   |   | 45   |
| Textbooks:                                                                                                                                                                                     |                                                                                                                                                                            |                       |                          |   |   |      |
| 1                                                                                                                                                                                              | Marc J. Schniederjans, Dara G. Schniederjans and Christopher M. Starkey,"Business Analytics Principles, Concepts, and Applications - What, Why, and How" ,Pearson Ed, 2014 |                       |                          |   |   |      |
| 2                                                                                                                                                                                              | Christian Albright S and Wayne L. Winston, "Business Analytics - Data Analysis andDecision Making", Fifth edition, Cengage Learning, 2015.                                 |                       |                          |   |   |      |
| ReferenceBooks:                                                                                                                                                                                |                                                                                                                                                                            |                       |                          |   |   |      |

|                       |                                                                                                                                                             |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                     | James R. Evans, "Business Analytics - Methods, Models and Decisions", Pearson Ed, 2012.                                                                     |
| <b>WebReferences:</b> |                                                                                                                                                             |
| 1                     | <a href="https://www.coursera.org/learn/introduction-to-business-analytics">https://www.coursera.org/learn/introduction-to-business-analytics</a>           |
| 2                     | <a href="https://onlinecourses.swayam2.ac.in/imb20_mg19/preview">https://onlinecourses.swayam2.ac.in/imb20_mg19/preview</a>                                 |
| 3                     | <a href="https://cce.iisc.ac.in/cce-proficiency/prescriptive-analytics-jm-2025/">https://cce.iisc.ac.in/cce-proficiency/prescriptive-analytics-jm-2025/</a> |

**Assessment based on Continuous and End Semester Examination**

| Bloom's Level            | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|--------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
|                          | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                 |                       |                   |                         | 100%       | 100%       | 100%                     |
| Understand               | 80%                   |                   | 20%                     |            |            |                          |
| Apply                    | 20%                   | 100%              | 80%                     |            |            |                          |
| Analyze                  |                       |                   |                         |            |            |                          |
| Evaluate                 |                       |                   |                         |            |            |                          |
| Create                   |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C604.1      | 2    | 1    | -    | -    | -    | -    | -    | -    | -    | 2     | 1     | 2     | 2     | 1     |
| C604.2      | 2    | 2    | 2    | 2    | -    | -    | -    | -    | 2    | 1     | 3     | 2     | 1     | 1     |
| C604.3      | 3    | 3    | 2    | 2    | 3    | -    | -    | -    | -    | 1     | -     | 3     | 2     | 3     |
| C604.4      | 3    | 3    | 3    | 3    | -    | -    | -    | -    | -    | 1     | -     | 3     | 3     | 2     |
| C604.5      | 3    | 3    | 3    | 2    | 2    | -    | -    | -    | -    | 1     | 2     | 3     | 3     | 2     |

| Course Code                                                                                                                                                                                                                                                                                                                                                                                              | CourseName                                                                                                                                                   | Category              | Hours/Week               |   |   | C    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|---|------|
|                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                              |                       | L                        | T | P |      |
| 24OE605                                                                                                                                                                                                                                                                                                                                                                                                  | DATASCIENCEESSENTIALS                                                                                                                                        | OE                    | 3                        | 0 | 0 | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                               | NatureoftheCourse                                                                                                                                            | Semester              | DataBook/Codes/Standards |   |   |      |
| R24                                                                                                                                                                                                                                                                                                                                                                                                      | Theory                                                                                                                                                       | -                     | --                       |   |   |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                              | Co-requisiteCourse(s) |                          |   |   |      |
| -                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                              | -                     |                          |   |   |      |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                              |                       |                          |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                        | To understand the Data Science steps to solve basic data-driven problems.                                                                                    |                       |                          |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                        | To manipulate data using NumPy, Pandas and identify optimization bottlenecks.                                                                                |                       |                          |   |   |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                        | To apply machine learning algorithms for classification and regression tasks.                                                                                |                       |                          |   |   |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                        | To create visualizations using Matplotlib and Seaborn for complex datasets.                                                                                  |                       |                          |   |   |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                        | To handle large datasets using efficient tools and programming techniques.                                                                                   |                       |                          |   |   |      |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                              |                       |                          |   |   |      |
| Uponcompletionofthecourse,studentsshallhaveabilityto                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                              |                       |                          |   |   |      |
| C605.1                                                                                                                                                                                                                                                                                                                                                                                                   | Understand the steps ofthe Data Science process, including defining research goals,retrieving data, and preparing data, to solve basic data-driven problems. |                       |                          |   |   | [U]  |
| C605.2                                                                                                                                                                                                                                                                                                                                                                                                   | Implement data manipulation methods in NumPy and Pandas, identifying potentialbottlenecks and areas for optimization.                                        |                       |                          |   |   | [AP] |
| C605.3                                                                                                                                                                                                                                                                                                                                                                                                   | Apply machine learning algorithms to solve classification and regression problems, usingappropriate tools and techniques.                                    |                       |                          |   |   | [AP] |
| C605.4                                                                                                                                                                                                                                                                                                                                                                                                   | Apply various data visualization techniques using Matplotlib and Seaborn to create andcustomize visual representations ofcomplex datasets                    |                       |                          |   |   | [AP] |
| C605.5                                                                                                                                                                                                                                                                                                                                                                                                   | Apply techniques and programming strategies to handle large volumes ofdata effectively byleveraging appropriate tools and methods                            |                       |                          |   |   | [AP] |
| CourseContents                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                              |                       |                          |   |   |      |
| Unit-I                                                                                                                                                                                                                                                                                                                                                                                                   | INTRODUCTION                                                                                                                                                 |                       |                          |   |   | 6    |
| Data Science: Benefits and uses – facets ofdata - DataScience Process:Overview–Definingresearch goals–retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings andbuilding applications - Data Mining - Data Warehousing– Basicstatisticaldescriptionsof Data.                                                                                             |                                                                                                                                                              |                       |                          |   |   |      |
| Unit-II                                                                                                                                                                                                                                                                                                                                                                                                  | DATAMANIPULATION                                                                                                                                             |                       |                          |   |   | 12   |
| Python Shell - Jupyter Notebook - IPython Magic Commands-NumPy Arrays-UniversalFunctions – Aggregations– Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data– Datamanipulation withPandas–Data Indexing and Selection – Handling missing data –Hierarchical indexing– Combiningdatasets– Aggregationand Grouping – String operations – Working with time series – High performance |                                                                                                                                                              |                       |                          |   |   |      |
| Unit-III                                                                                                                                                                                                                                                                                                                                                                                                 | MACHINELEARNING                                                                                                                                              |                       |                          |   |   | 9    |
| The modeling process - Types ofmachine learning - Supervised learning - Unsupervised learning - Semi-supervised learning- Classification, regression - Clustering - Outliers and Outlier Analysis.                                                                                                                                                                                                       |                                                                                                                                                              |                       |                          |   |   |      |
| Unit-IV                                                                                                                                                                                                                                                                                                                                                                                                  | DATAVISUALIZATION                                                                                                                                            |                       |                          |   |   | 9    |
| Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – densityandcontour plots–Histograms – legends – colors – subplots – text and annotation – customization – three-dimensional plotting -Geographic Data with Basemap - Visualization with Seaborn.                                                                                                                   |                                                                                                                                                              |                       |                          |   |   |      |
| Unit-V                                                                                                                                                                                                                                                                                                                                                                                                   | HANDLINGLARGEDATA                                                                                                                                            |                       |                          |   |   | 9    |
| Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets-Case studies: Predicting malicious URLs, building a recommender system - Tools and techniques needed - Research question - Data preparation - Model building – Presentation andautomation.                                                                                                  |                                                                                                                                                              |                       |                          |   |   |      |
| TotalHours                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                              |                       |                          |   |   | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                              |                       |                          |   |   |      |

|   |                                                                                                            |
|---|------------------------------------------------------------------------------------------------------------|
| 1 | David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. |
|---|------------------------------------------------------------------------------------------------------------|

|                         |                                                                                                                             |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| 2                       | Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.                                                            |
| <b>Reference Books:</b> |                                                                                                                             |
| 1                       | Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017                                 |
| 2                       | Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.                                 |
| <b>Web References:</b>  |                                                                                                                             |
| 1                       | <a href="https://onlinecourses.nptel.ac.in/noc24_cs68/preview">https://onlinecourses.nptel.ac.in/noc24_cs68/preview</a>     |
| 2                       | <a href="https://archive.nptel.ac.in/courses/106/106/106106139/">https://archive.nptel.ac.in/courses/106/106/106106139/</a> |

**Assessment based on Continuous and End Semester Examination**

| Bloom's Level            | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|--------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
|                          | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                 |                       |                   |                         | 100%       | 100%       | 100%                     |
| Understand               | 50%                   |                   | 20%                     |            |            |                          |
| Apply                    | 50%                   | 100%              | 80%                     |            |            |                          |
| Analyze                  |                       |                   |                         |            |            |                          |
| Evaluate                 |                       |                   |                         |            |            |                          |
| Create                   |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO1<br>0 | PO1<br>1 | PS0<br>1 | PS0<br>2 | PS03 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|------|
| C605.1      | 3       | 3       | 2       | 2       | 3       | 1       | 1       | 1       | 1       | 2        | 1        | 3        | 2        | 3    |
| C605.2      | 3       | 3       | 3       | 2       | 3       | 1       | 1       | 1       | 1       | 1        | 2        | 3        | 3        | 3    |
| C605.3      | 3       | 3       | 3       | 3       | 3       | 1       | 1       | 1       | 2       | 2        | 2        | 3        | 3        | 3    |
| C605.4      | 2       | 2       | 3       | 2       | 3       | 1       | 1       | 1       | 2       | 3        | 2        | 2        | 3        | 2    |
| C605.5      | 3       | 3       | 3       | 3       | 3       | 2       | 1       | 1       | 2       | 2        | 3        | 3        | 3        | 3    |

| Course Code                                                                                                                                                                                                                                                                                                         | Course Name                                                                                                                                     | Category               | Hours/Week                |   |   | C        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----------|
|                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                 |                        | L                         | T | P |          |
| 24OE606                                                                                                                                                                                                                                                                                                             | FUNDAMENTALS OF COMPUTER VISION                                                                                                                 | OE                     | 3                         | 0 | 0 | 3        |
| Regulation                                                                                                                                                                                                                                                                                                          | Nature of the Course                                                                                                                            | Semester               | Data Book/Codes/Standards |   |   |          |
| 2024                                                                                                                                                                                                                                                                                                                | Theory                                                                                                                                          | VI                     | -                         |   |   |          |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                             |                                                                                                                                                 | Co-requisite Course(s) |                           |   |   |          |
| Programming in C, Probability and Statistics                                                                                                                                                                                                                                                                        |                                                                                                                                                 | -                      |                           |   |   |          |
| Course Objectives                                                                                                                                                                                                                                                                                                   |                                                                                                                                                 |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                   | To understand the fundamental concepts related to Image formation and processing.                                                               |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                   | To learn feature detection, matching and detection                                                                                              |                        |                           |   |   |          |
| 3                                                                                                                                                                                                                                                                                                                   | To become familiar with feature-based alignment and motion estimation                                                                           |                        |                           |   |   |          |
| 4                                                                                                                                                                                                                                                                                                                   | To develop skills on 3D reconstruction                                                                                                          |                        |                           |   |   |          |
| 5                                                                                                                                                                                                                                                                                                                   | To understand image-based rendering and recognition                                                                                             |                        |                           |   |   |          |
| Course Outcomes                                                                                                                                                                                                                                                                                                     |                                                                                                                                                 |                        |                           |   |   |          |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                             |                                                                                                                                                 |                        |                           |   |   |          |
| C606.1                                                                                                                                                                                                                                                                                                              | To understand basic knowledge, theories and methods in image processing and computer vision.                                                    |                        |                           |   |   | [U]      |
| C606.2                                                                                                                                                                                                                                                                                                              | To implement basic and some advanced image processing techniques in OpenCV.                                                                     |                        |                           |   |   | [AP]     |
| C606.3                                                                                                                                                                                                                                                                                                              | To apply 2D feature-based image alignment, segmentation and motion estimations.                                                                 |                        |                           |   |   | [AP]     |
| C606.4                                                                                                                                                                                                                                                                                                              | To apply 3D image reconstruction techniques                                                                                                     |                        |                           |   |   | [AP]     |
| C606.5                                                                                                                                                                                                                                                                                                              | To design and develop innovative image processing and computer vision applications.                                                             |                        |                           |   |   | [AP]     |
| Course Contents                                                                                                                                                                                                                                                                                                     |                                                                                                                                                 |                        |                           |   |   |          |
| Unit-1                                                                                                                                                                                                                                                                                                              | INTRODUCTION TO IMAGE FORMATION AND PROCESSING                                                                                                  |                        |                           |   |   | C01 9Hrs |
| Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.                                    |                                                                                                                                                 |                        |                           |   |   |          |
| Unit-2                                                                                                                                                                                                                                                                                                              | FEATURE DETECTION, MATCHING AND SEGMENTATION                                                                                                    |                        |                           |   |   | C02 9Hrs |
| Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.                                                                                                                                        |                                                                                                                                                 |                        |                           |   |   |          |
| Unit-3                                                                                                                                                                                                                                                                                                              | FEATURE-BASED ALIGNMENT & MOTION ESTIMATION                                                                                                     |                        |                           |   |   | C03 9Hrs |
| 2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion. |                                                                                                                                                 |                        |                           |   |   |          |
| Unit-4                                                                                                                                                                                                                                                                                                              | 3D RECONSTRUCTION                                                                                                                               |                        |                           |   |   | C04 9Hrs |
| Shape from X - Active range finding - Surface representations - Point-based representations - Volumetric representations - Model-based reconstruction - Recovering texture maps and albedos.                                                                                                                        |                                                                                                                                                 |                        |                           |   |   |          |
| Unit-5                                                                                                                                                                                                                                                                                                              | IMAGE-BASED RENDERING AND RECOGNITION                                                                                                           |                        |                           |   |   | C05 9Hrs |
| View interpolation - Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering - Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding - Recognition databases and test sets.                                   |                                                                                                                                                 |                        |                           |   |   |          |
| Total Hours                                                                                                                                                                                                                                                                                                         |                                                                                                                                                 |                        |                           |   |   | 45       |
| Textbooks:                                                                                                                                                                                                                                                                                                          |                                                                                                                                                 |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                   | D. A. Forsyth, J. Ponce, <i>Computer Vision: A Modern Approach</i> , 2nd Edition, Pearson India, Latest Reprint 2025.                           |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                   | Richard Szeliski, <i>Computer Vision: Algorithms and Applications</i> , 2nd Edition, Springer, 2022.                                            |                        |                           |   |   |          |
| Reference Books:                                                                                                                                                                                                                                                                                                    |                                                                                                                                                 |                        |                           |   |   |          |
| 1                                                                                                                                                                                                                                                                                                                   | Richard Hartley and Andrew Zisserman, <i>Multiple View Geometry in Computer Vision</i> , Second Edition, Cambridge University Press, March 2004 |                        |                           |   |   |          |
| 2                                                                                                                                                                                                                                                                                                                   | Christopher M. Bishop; <i>Pattern Recognition and Machine Learning</i> , Springer, 2006                                                         |                        |                           |   |   |          |
| Web References:                                                                                                                                                                                                                                                                                                     |                                                                                                                                                 |                        |                           |   |   |          |



|   |                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------|
| 1 | <a href="https://archive.nptel.ac.in/courses/106/105/106105216/">https://archive.nptel.ac.in/courses/106/105/106105216/</a> |
| 2 | <a href="https://opencv.org/opencv-free-course/">https://opencv.org/opencv-free-course/</a>                                 |

| Assessment based on Continuous and End Semester Examination |                       |               |                     |            |            |                          |
|-------------------------------------------------------------|-----------------------|---------------|---------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |               |                     | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6Marks)         | CIA2 (6Marks) | Model Exam (8Marks) | (10Marks)  | (10Marks)  | (60Marks)                |
| Remember                                                    |                       |               |                     | 10         | 10         |                          |
| Understand                                                  | 20                    | 20            | 20                  |            |            |                          |
| Apply                                                       | 80                    | 80            | 80                  |            |            |                          |
| Analyze                                                     |                       |               |                     |            |            |                          |
| Evaluate                                                    |                       |               |                     |            |            |                          |
| Create                                                      |                       |               |                     |            |            |                          |
| <b>Total (100Marks)</b>                                     | <b>6</b>              | <b>6</b>      | <b>8</b>            | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C606.1      | 3    | 2    | -    | -    | 2    | -    | -    | -    | -    | -     | 2     | 2     | -     |
| C606.2      | 3    | 3    | 2    | 2    | 3    | -    | -    | -    | -    | -     | 2     | 3     | 2     |
| C606.3      | 3    | 2    | 2    | 2    | 3    | -    | -    | -    | -    | -     | 2     | 3     | 2     |
| C606.4      | 3    | 3    | 3    | 3    | 2    | -    | -    | -    | -    | -     | 2     | 3     | 2     |
| C606.5      | 3    | 3    | 2    | 3    | 3    | 2    | 2    | 2    | 2    | -     | 3     | 3     | 2     |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                      | Course Name                                                                                        | Category               | Hours/Week                |   |   | C  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----|
|                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                    |                        | L                         | T | P |    |
| 24OE607                                                                                                                                                                                                                                                                                                                                                                                                          | Machine Learning and its Applications                                                              | OE                     | 3                         | 0 | 0 | 3  |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                       | Nature of the Course                                                                               | Semester               | Data Book/Codes/Standards |   |   |    |
| R24                                                                                                                                                                                                                                                                                                                                                                                                              | THEORY                                                                                             |                        | -----                     |   |   |    |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                    | Co-requisite Course(s) |                           |   |   |    |
| Nil                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                    | -                      |                           |   |   |    |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                    |                        |                           |   |   |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                | To understand the basic concepts of machine learning.                                              |                        |                           |   |   |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                | To understand and build supervised learning models.                                                |                        |                           |   |   |    |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                | To understand and build unsupervised learning models.                                              |                        |                           |   |   |    |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                | To design the algorithms based on corresponding metrics identified.                                |                        |                           |   |   |    |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                | To make use of classification algorithms, build the machine learning experiments.                  |                        |                           |   |   |    |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                    |                        |                           |   |   |    |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                                                                                                    |                                                                                                    |                        |                           |   |   |    |
| C607.1                                                                                                                                                                                                                                                                                                                                                                                                           | Understand the fundamental concepts and applications of machine learning.                          |                        |                           |   |   | U  |
| C607.2                                                                                                                                                                                                                                                                                                                                                                                                           | Apply preprocessing techniques and appropriate machine learning algorithms to real-world problems. |                        |                           |   |   | AP |
| C607.3                                                                                                                                                                                                                                                                                                                                                                                                           | Apply supervised learning algorithms and evaluate model performance.                               |                        |                           |   |   | AP |
| C607.4                                                                                                                                                                                                                                                                                                                                                                                                           | Implement ensemble and unsupervised learning techniques.                                           |                        |                           |   |   | AP |
| C607.5                                                                                                                                                                                                                                                                                                                                                                                                           | Design, evaluate, and compare machine learning experiments using appropriate statistical tools.    |                        |                           |   |   | AP |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                    |                        |                           |   |   |    |
| Unit -1                                                                                                                                                                                                                                                                                                                                                                                                          | INTRODUCTION TO MACHINE LEARNING                                                                   |                        |                           |   |   | 9  |
| Introduction to Machine Learning and its importance, Types of Machine Learning: Supervised, Unsupervised, and Reinforcement Learning, Basic concepts: features, labels, training data, etc., Popular Machine Learning algorithms: Linear Regression, Logistic Regression, Decision Trees, k-Nearest Neighbors, etc., Evaluation metrics for Machine Learning models: accuracy, precision, recall, F1-score, etc. |                                                                                                    |                        |                           |   |   |    |
| Unit - 2                                                                                                                                                                                                                                                                                                                                                                                                         | MACHINE LEARNING TECHNIQUES                                                                        |                        |                           |   |   | 9  |
| Machine Learning Techniques Data preprocessing techniques: handling missing data, feature scaling, feature encoding, etc., Model selection and hyperparameter tuning, Cross-validation techniques, Ensemble methods: Bagging, Boosting, Random Forests, etc., Introduction to deep learning and neural networks                                                                                                  |                                                                                                    |                        |                           |   |   |    |
| Unit - 3                                                                                                                                                                                                                                                                                                                                                                                                         | SUPERVISED LEARNING                                                                                |                        |                           |   |   | 9  |
| Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function - Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model - Naive Bayes, Maximum margin classifier - Support vector machine, Decision Tree, Random Forests.                       |                                                                                                    |                        |                           |   |   |    |
| Unit - 4                                                                                                                                                                                                                                                                                                                                                                                                         | APPLICATIONS OF MACHINE LEARNING                                                                   |                        |                           |   |   | 9  |
| Ensemble learning applications, Voting technique, Bagging method, Boosting method, Stacking approach, Recommendation systems, K-means clustering for segmentation, KNN for classification, Anomaly detection.                                                                                                                                                                                                    |                                                                                                    |                        |                           |   |   |    |
| Unit -5                                                                                                                                                                                                                                                                                                                                                                                                          | MACHINE LEARNING PROJECT DESIGN AND ANALYSIS                                                       |                        |                           |   |   | 9  |
| Problem definition, Data collection, Data preprocessing, Model training (classification), Model training (regression), Model evaluation metrics, Model comparison, Model deployment basics, Ethical issues and challenges in real-world machine learning applications.                                                                                                                                           |                                                                                                    |                        |                           |   |   |    |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                    |                        |                           |   |   | 45 |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                    |                        |                           |   |   |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                | Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.               |                        |                           |   |   |    |

|                        |                                                                                                                                                                         |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2                      | Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "SecondEdition",CRCPress,2022.                                                                         |
| <b>ReferenceBooks:</b> |                                                                                                                                                                         |
| 1                      | Christopher M. Bishop, "Pattern Recognition and Machine Learning",Springer, 2006.                                                                                       |
| 2                      | Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997.                                                                                                        |
| 3                      | MehryarMohri, AfshinRostamizadeh, AmeetTalwalkar,"FoundationsofMachineLearning",Second Edition, MIT Press, 2018.                                                        |
| 4                      | Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2016                                                                                         |
| 5                      | SebastainRaschka,VahidMirjalili , "PythonMachineLearning",Packtpublishing 3rdEdition,2019.                                                                              |
| <b>WebReferences:</b>  |                                                                                                                                                                         |
| 1                      | <a href="https://www.coursera.org/lecture/python-machine-learning/introduction-4f2So2">https://www.coursera.org/lecture/python-machine-learning/introduction-4f2So2</a> |
| 2                      | <a href="https://nptel.ac.in/courses/106/106/106106139/">https://nptel.ac.in/courses/106/106/106106139/</a>                                                             |

**AssessmentbasedonContinuousandEndSemesterExamination**

| Bloom'sLevel           | ContinuousAssessment |                  |                       | Assignm<br>e<br>nt | Attenda<br>n<br>ce | EndSemester<br>Examination |
|------------------------|----------------------|------------------|-----------------------|--------------------|--------------------|----------------------------|
|                        | CIA1<br>(6Marks)     | CIA2<br>(6Marks) | ModelExam<br>(8Marks) |                    |                    |                            |
| Remember               |                      |                  |                       | (10<br>Marks)      | (10<br>Marks)      | (60Marks)                  |
| Understand             | 80%                  | 20%              | 20%                   |                    |                    |                            |
| Apply                  | 20%                  | 80%              | 80%                   |                    |                    |                            |
| Analyze                |                      |                  |                       |                    |                    |                            |
| Evaluate               |                      |                  |                       |                    |                    |                            |
| Create                 |                      |                  |                       |                    |                    |                            |
| <b>Total(100Marks)</b> | <b>6</b>             | <b>6</b>         | <b>8</b>              | <b>10</b>          | <b>10</b>          | <b>60</b>                  |

- CIA1, CIA 2 and ModelExam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | P<br>01 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PSO<br>1 | PSO<br>2 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|
| C607.1      | 3       | 2       | -       | -       | 2       | -       | -       | -       | -       | -        | 1        | -        | 3        |
| C607.2      | 3       | 3       | 2       | 2       | 3       | -       | -       | -       | -       | -        | 2        | -        | 3        |
| C607.3      | 3       | 3       | 3       | 2       | 3       | -       | -       | -       | -       | -        | 2        | -        | 3        |
| C607.4      | 3       | 3       | 3       | 3       | 3       | -       | -       | -       | -       | -        | 2        | -        | 3        |
| C607.5      | 3       | 3       | 3       | 3       | 3       | -       | -       | -       | -       | -        | 3        | -        | 3        |

3 -Strong 2 - Moderate 1- Weak -- no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                     | CourseName                                                                        | Category                | Hours/Week               |   |     | C  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------|--------------------------|---|-----|----|
|                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                   |                         | L                        | T | P   |    |
| 240E608                                                                                                                                                                                                                                                                                                                                                                         | Deep Learning Techniques                                                          | OE                      | 3                        | 0 | 0   | 3  |
| Regulation                                                                                                                                                                                                                                                                                                                                                                      | NatureoftheCourse                                                                 | Semester                | DataBook/Codes/Standards |   |     |    |
| 2024                                                                                                                                                                                                                                                                                                                                                                            | Theory                                                                            | V                       | -                        |   |     |    |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                                          |                                                                                   | Co-requisiteCourse(s)   |                          |   |     |    |
| Fundamentals of Machine Learning                                                                                                                                                                                                                                                                                                                                                |                                                                                   | Artificial Intelligence |                          |   |     |    |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                                                |                                                                                   |                         |                          |   |     |    |
| 1                                                                                                                                                                                                                                                                                                                                                                               | To understand principles of deep neural networks.                                 |                         |                          |   |     |    |
| 2                                                                                                                                                                                                                                                                                                                                                                               | To understand CNN architectures of deep neural networks.                          |                         |                          |   |     |    |
| 3                                                                                                                                                                                                                                                                                                                                                                               | To understand RNN architectures of deep neural networks.                          |                         |                          |   |     |    |
| 4                                                                                                                                                                                                                                                                                                                                                                               | To comprehend advanced deep learning models.                                      |                         |                          |   |     |    |
| 5                                                                                                                                                                                                                                                                                                                                                                               | To learn the evaluation metrics for deep learning models.                         |                         |                          |   |     |    |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                                                  |                                                                                   |                         |                          |   |     |    |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                                                         |                                                                                   |                         |                          |   |     |    |
| C608.1                                                                                                                                                                                                                                                                                                                                                                          | Understand the basics in deep neural networks.                                    |                         |                          |   |     | U  |
| C608.2                                                                                                                                                                                                                                                                                                                                                                          | Apply Convolution Neural Network for image processing.                            |                         |                          |   |     | AP |
| C608.3                                                                                                                                                                                                                                                                                                                                                                          | Apply Recurrent Neural Network and its variants for text analysis.                |                         |                          |   |     | AP |
| C608.4                                                                                                                                                                                                                                                                                                                                                                          | Demonstrate the model evaluation for various applications.                        |                         |                          |   |     | AP |
| C608.5                                                                                                                                                                                                                                                                                                                                                                          | Apply autoencoders and generative models for suitable applications.               |                         |                          |   |     | AP |
| CourseContents                                                                                                                                                                                                                                                                                                                                                                  |                                                                                   |                         |                          |   |     |    |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                          | DEEP NETWORKS BASICS                                                              |                         |                          |   | C01 | 10 |
| Linear Algebra: Scalars -- Vectors -- Matrices and tensors; Probability Distributions -- Gradient-based Optimization -- Machine Learning Basics: Capacity -- Overfitting and underfitting -- Hyperparameters and validation sets -- Estimators -- Bias and variance -- Stochastic gradient descent -- Deep Networks: Deep feedforward networks; Regularization -- Optimization. |                                                                                   |                         |                          |   |     |    |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                          | CONVOLUTIONAL NEURAL NETWORKS                                                     |                         |                          |   | C02 | 10 |
| Convolution Operation -- Sparse Interactions -- Parameter Sharing -- Equivariance -- Pooling -- Convolution Variants: Strided -- Tiled -- Transposed and dilated convolutions; CNN Learning: Nonlinearity Functions -- Loss Functions -- Regularization -- Optimizers -- Gradient Computation.                                                                                  |                                                                                   |                         |                          |   |     |    |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                          | RECURRENT NEURAL NETWORKS                                                         |                         |                          |   | C03 | 9  |
| Unfolding Graphs -- RNN Design Patterns: Acceptor -- Encoder -- Transducer; Gradient Computation -- Sequence Modeling Conditioned on Contexts -- Bidirectional RNN -- Sequence to Sequence RNN -- Deep Recurrent Networks -- Recursive Neural Networks -- Long Term Dependencies; Leaky Units: Skip connections and dropouts; Gated Architecture: LSTM.                         |                                                                                   |                         |                          |   |     |    |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                          | MODEL EVALUATION                                                                  |                         |                          |   | C04 | 8  |
| Performance metrics -- Baseline Models -- Hyperparameters: Manual Hyperparameter -- Automatic Hyperparameter -- Grid search -- Random search -- Debugging strategies.                                                                                                                                                                                                           |                                                                                   |                         |                          |   |     |    |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                          | AUTOENCODERS AND GENERATIVE MODELS                                                |                         |                          |   | C05 | 8  |
| Autoencoders: Undercomplete autoencoders -- Regularized autoencoders -- Stochastic encoders and decoders -- Learning with autoencoders; Deep Generative Models: Variational autoencoders -- Generative adversarial networks - DALL-E, DALL-E 2 and IMAGEN                                                                                                                       |                                                                                   |                         |                          |   |     |    |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                     |                                                                                   |                         |                          |   |     | 45 |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                      |                                                                                   |                         |                          |   |     |    |
| 1                                                                                                                                                                                                                                                                                                                                                                               | Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2018. |                         |                          |   |     |    |
| 2                                                                                                                                                                                                                                                                                                                                                                               | Andrew Glassner, "Deep Learning: A Visual Approach", No Starch Press, 2021.       |                         |                          |   |     |    |

|                         |                                                                                                                                                                                                                  |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3                       | Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, "A Guide to Convolutional Neural Networks for Computer Vision", Synthesis Lectures on Computer Vision, Morgan & Claypool publishers, 2018. |
| <b>Reference Books:</b> |                                                                                                                                                                                                                  |
| 1                       | Francois Chollet, "Deep Learning with Python", Manning Publications Co, 2018.                                                                                                                                    |
| 2                       | Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 2018.                                                                                                     |
| 3                       | Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2021.                                                                                                                   |
| 4                       | Yoav Goldberg, "Neural Network Methods for Natural Language Processing", Synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2020.                                                  |
| <b>Web References:</b>  |                                                                                                                                                                                                                  |
| 1                       | <a href="https://nptel.ac.in/courses/">https://nptel.ac.in/courses/</a>                                                                                                                                          |
| 2                       | <a href="https://aikosh.indiaai.gov.in/static/Deep+Learning+lan+Goodfellow.pdf">https://aikosh.indiaai.gov.in/static/Deep+Learning+lan+Goodfellow.pdf</a>                                                        |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      | 10         | 10         | 60                       |
| Understand                                                  | 80                    | 20             | 20                   |            |            |                          |
| Apply                                                       | 20                    | 80             | 80                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PS 01 | PS 02 |
|---------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|
| C608.1  | 3    | 2    | 1    | -    | 1    | -    | -    | -    | -    | -     | -     | 2     | 1     |
| C608.2  | 3    | 3    | 2    | 2    | 3    | -    | -    | -    | -    | -     | 1     | 3     | 2     |
| C608.3  | 2    | 3    | 3    | 2    | 3    | -    | -    | -    | 1    | -     | 1     | 3     | 3     |
| C608.4  | 2    | 3    | 2    | 3    | 2    | -    | -    | -    | -    | -     | 1     | 2     | 2     |
| C608.5  | 1    | 2    | 3    | 2    | 3    | -    | -    | -    | 1    | 1     | 1     | 3     | 3     |

1-low, 2-medium, 3-high, '-'-no correlation

| CourseCode                                                                                                                                                                                                                                                 | CourseName                                                         | Category                  | Hours/Week                | C |   |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|---------------------------|---------------------------|---|---|----|
|                                                                                                                                                                                                                                                            |                                                                    |                           | L                         | T | P |    |
| 24OE609                                                                                                                                                                                                                                                    | Language engineering                                               | OE                        | 3                         | 0 | 2 | 4  |
| Regulation                                                                                                                                                                                                                                                 | NatureoftheCourse                                                  | Semester                  | Data Book/Codes/Standards |   |   |    |
| R24                                                                                                                                                                                                                                                        | Theory                                                             | 4                         | -----                     |   |   |    |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                     |                                                                    | Co-requisiteCourse(s)     |                           |   |   |    |
| Nil                                                                                                                                                                                                                                                        |                                                                    | NaturalLanguageprocessing |                           |   |   |    |
| CourseObjectives                                                                                                                                                                                                                                           |                                                                    |                           |                           |   |   |    |
| 1                                                                                                                                                                                                                                                          | Tounderstandthefundamentalsofnaturallanguageprocessing             |                           |                           |   |   |    |
| 2                                                                                                                                                                                                                                                          | To construct the word level analysis methods                       |                           |                           |   |   |    |
| 3                                                                                                                                                                                                                                                          | To identify word class methods and models                          |                           |                           |   |   |    |
| 4                                                                                                                                                                                                                                                          | To construct Context Free Grammar in syntacticanalysis             |                           |                           |   |   |    |
| 5                                                                                                                                                                                                                                                          | To develop parsing concepts in syntacticanalysis                   |                           |                           |   |   |    |
| CourseOutcomes                                                                                                                                                                                                                                             |                                                                    |                           |                           |   |   |    |
| Uponcompletionofthecourse,studentsshallhaveabilityto                                                                                                                                                                                                       |                                                                    |                           |                           |   |   |    |
| C609.1                                                                                                                                                                                                                                                     | Understand basic language features for the given text.             |                           |                           |   |   | U  |
| C609.2                                                                                                                                                                                                                                                     | Buildarulebasedsystemtotacklemorphology/syntaxofalanguage          |                           |                           |   |   | AP |
| C609.3                                                                                                                                                                                                                                                     | Build a rule based tagging and models for word level applications. |                           |                           |   |   | AP |
| C609.4                                                                                                                                                                                                                                                     | Apply different statistical approaches for CFGapplications.        |                           |                           |   |   | AP |
| C609.5                                                                                                                                                                                                                                                     | Build innovative parsing concepts to process natural language.     |                           |                           |   |   | AP |
| CourseContents                                                                                                                                                                                                                                             |                                                                    |                           |                           |   |   |    |
| Unit –1                                                                                                                                                                                                                                                    | INTRODUCTION                                                       |                           |                           |   |   | 9  |
| Origins andchallengesofNLP – Language Modeling:Grammar-based LM,StatisticalLM-RegularExpressions,Finite- State Automata – English Morphology, Transducers for lexiconand rules,Tokenization,DetectingandCorrecting Spelling Errors, Minimum Edit Distance. |                                                                    |                           |                           |   |   |    |
| Unit – 2                                                                                                                                                                                                                                                   | WORD LEVEL ANALYSIS                                                |                           |                           |   |   | 9  |
| UnsmoothedN-grams, EvaluatingN-grams, Smoothing, InterpolationandBackoff–WordClasses,Part-of-SpeechTagging.                                                                                                                                                |                                                                    |                           |                           |   |   |    |
| Unit – 3                                                                                                                                                                                                                                                   | WORD LEVEL MODELS                                                  |                           |                           |   |   | 9  |
| Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markovand MaximumEntropy models.                                                                                                                                   |                                                                    |                           |                           |   |   |    |
| Unit – 4                                                                                                                                                                                                                                                   | SYNTACTIC ANALYSIS -Context-Free Grammars                          |                           |                           |   |   | 9  |

|                                                                                                                                                                                                 |                                                                                                                                                                                 |    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – DependencyGrammar.                                                                                      |                                                                                                                                                                                 |    |
| Unit – 5                                                                                                                                                                                        | SYNTACTIC ANALYSIS -Parsing concepts                                                                                                                                            | 9  |
| SyntacticParsing,Ambiguity,DynamicProgrammingparsing–Shallow85parsing–ProbabilisticCFG,Probabilistic CYK,Probabilistic Lexicalized CFGs - Feature structures, Unification offeature structures. |                                                                                                                                                                                 |    |
| TotalHours                                                                                                                                                                                      |                                                                                                                                                                                 | 45 |
| Textbooks:                                                                                                                                                                                      |                                                                                                                                                                                 |    |
| 1                                                                                                                                                                                               | Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introductionto NaturalLanguage Processing, Computational Linguistics and Speech, Pearson Publication, 2014. |    |
| 2                                                                                                                                                                                               | StevenBird,EwanKleinandEdwardLoper,—NaturalLanguageProcessingwithPython,FirstEdition,O’R eilly Media, 2009.                                                                     |    |
| ReferenceBooks:                                                                                                                                                                                 |                                                                                                                                                                                 |    |
| 1                                                                                                                                                                                               | Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.                                                                                  |    |
| 2                                                                                                                                                                                               | Richard M Reese, —Natural Language Processing with Java  , O’Reilly Media, 2015.                                                                                                |    |
| 4                                                                                                                                                                                               | TanveerSiddiqui,U.S.Tiwary,“NaturalLanguageProcessingandInformationRetrieval”,Oxford University Press, 2008.                                                                    |    |
| WebReferences:                                                                                                                                                                                  |                                                                                                                                                                                 |    |
| 1                                                                                                                                                                                               | https://onlinecourses.nptel.ac.in/noc23_cs45/preview                                                                                                                            |    |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                                                    |                       |                   |                         | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand                                                  | 80%                   | 20%               | 20%                     |            |            |                          |
| Apply                                                       | 20%                   | 80%               | 80%                     |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| <b>COs/<br/>POs</b> | <b>PO<br/>1</b> | <b>PO<br/>2</b> | <b>PO<br/>3</b> | <b>PO<br/>4</b> | <b>PO<br/>5</b> | <b>PO<br/>6</b> | <b>PO<br/>7</b> | <b>PO<br/>8</b> | <b>PO<br/>9</b> | <b>PO1<br/>0</b> | <b>PO1<br/>1</b> | <b>PO1<br/>2</b> | <b>PS0<br/>1</b> | <b>PS0<br/>2</b> |
|---------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|------------------|------------------|
| C609.1              | 3               | 2               | 1               | 2               | 1               | -               | -               | -               | -               | 1                | -                | -                | -                | 2                |
| C609.2              | 3               | 3               | 2               | 2               | -               | -               | -               | -               | -               | 2                | -                | -                | -                | 2                |
| C609.3              | 3               | 3               | 2               | 3               | -               | -               | -               | -               | -               | 2                | -                | -                | -                | 2                |
| C609.4              | 3               | 3               | 2               | 2               | -               | -               | -               | -               | -               | 1                | -                | -                | -                | 2                |
| C609.5              | 3               | 3               | 3               | 3               | -               | -               | -               | -               | -               | 2                | -                | -                | -                | 2                |

3 -Strong 2 - Moderate 1- Weak - - no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                      | Course Name                                                                                                                                                                                                       | Category                | Hours/Week                |   |   | C           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------------------|---|---|-------------|
|                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                   |                         | L                         | T | P |             |
| 24OE610                                                                                                                                                                                                                                                                                                                                          | Neural Networks                                                                                                                                                                                                   | OE                      | 3                         | 0 | 0 | 3           |
| Regulation                                                                                                                                                                                                                                                                                                                                       | Nature of the Course                                                                                                                                                                                              | Semester                | Data Book/Codes/Standards |   |   |             |
| 24                                                                                                                                                                                                                                                                                                                                               | THEORY                                                                                                                                                                                                            | VI                      |                           |   |   |             |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                   | Co-requisite Course(s)  |                           |   |   |             |
| Programming Fundamentals                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                   | Artificial Intelligence |                           |   |   |             |
| Course Objectives                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                   |                         |                           |   |   |             |
| 1                                                                                                                                                                                                                                                                                                                                                | Introduce the basic concepts of biological neurons and artificial neural networks.                                                                                                                                |                         |                           |   |   |             |
| 2                                                                                                                                                                                                                                                                                                                                                | Explain different neural network architectures and learning algorithms.                                                                                                                                           |                         |                           |   |   |             |
| 3                                                                                                                                                                                                                                                                                                                                                | Provide knowledge of fuzzy sets, fuzzy logic, and fuzzy reasoning systems.                                                                                                                                        |                         |                           |   |   |             |
| 4                                                                                                                                                                                                                                                                                                                                                | Understand fuzzy inference systems and fuzzy controllers used in industrial applications.                                                                                                                         |                         |                           |   |   |             |
| 5                                                                                                                                                                                                                                                                                                                                                | Explain the principles and applications of genetic algorithms for optimization problems.                                                                                                                          |                         |                           |   |   |             |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                   |                         |                           |   |   |             |
| Upon completion of the course, students will be able to                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                   |                         |                           |   |   |             |
| C610.1                                                                                                                                                                                                                                                                                                                                           | Explain the structure and working of biological and artificial neural networks.                                                                                                                                   |                         |                           |   |   | [U]         |
| C610.2                                                                                                                                                                                                                                                                                                                                           | Apply perceptron learning and backpropagation algorithm to neural network models.                                                                                                                                 |                         |                           |   |   | [AP]        |
| C610.3                                                                                                                                                                                                                                                                                                                                           | Understand fuzzy sets, fuzzy relations and operations in fuzzy logic.                                                                                                                                             |                         |                           |   |   | [U]         |
| C610.4                                                                                                                                                                                                                                                                                                                                           | Design fuzzy inference systems and fuzzy controllers for real-world applications.                                                                                                                                 |                         |                           |   |   | [AP]        |
| C610.5                                                                                                                                                                                                                                                                                                                                           | Apply genetic algorithms for optimization and problem solving                                                                                                                                                     |                         |                           |   |   | [AP]        |
| Course Contents                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                   |                         |                           |   |   |             |
| Unit-1                                                                                                                                                                                                                                                                                                                                           | Introduction & Architecture                                                                                                                                                                                       |                         |                           |   |   | C01   9Hrs  |
| Neuron, nerve structure and synapse. Artificial neuron and its model. Activation functions. Neural network architecture: single layer feedforward networks, multilayer feedforward networks, recurrent networks. Various learning techniques: perceptron learning rule, convergence rule. Auto-associative memory and hetero-associative memory. |                                                                                                                                                                                                                   |                         |                           |   |   |             |
| Unit-2                                                                                                                                                                                                                                                                                                                                           | Back Propagation Networks                                                                                                                                                                                         |                         |                           |   |   | C02   10Hrs |
| Architecture of neural networks. Perceptron model and solution. Single layer artificial neural network. Multilayer perceptron model. Backpropagation learning methods. Effect of learning rule coefficient. Backpropagation algorithm. Factors affecting back propagation training. Applications of back propagation networks.                   |                                                                                                                                                                                                                   |                         |                           |   |   |             |
| Unit-3                                                                                                                                                                                                                                                                                                                                           | Fuzzy Logic-I (Introduction)                                                                                                                                                                                      |                         |                           |   |   | C03   8Hrs  |
| Basic concepts of fuzzy logic. Fuzzy sets and crisp sets. Fuzzy set theory and operations. Properties of fuzzy sets. Fuzzy relations and crisp relations. Fuzzy to crisp conversion.                                                                                                                                                             |                                                                                                                                                                                                                   |                         |                           |   |   |             |
| Unit-4                                                                                                                                                                                                                                                                                                                                           | Fuzzy Logic-II (Membership Functions and Rules)                                                                                                                                                                   |                         |                           |   |   | C04   9Hrs  |
| Membership functions. Inference in fuzzy logic. Fuzzy IF-THEN rules. Fuzzy implications and fuzzy algorithms. Fuzzification and defuzzification. Fuzzy controller. Industrial applications of fuzzy logic.                                                                                                                                       |                                                                                                                                                                                                                   |                         |                           |   |   |             |
| Unit-5                                                                                                                                                                                                                                                                                                                                           | Genetic Algorithms (GA)                                                                                                                                                                                           |                         |                           |   |   | C05   9Hrs  |
| Basic concepts of genetic algorithms. Working principle of GA. Procedure of GA. Flow chart of GA. Genetic representation (encoding). Initialization and selection. Genetic operators. Mutation. Generational cycle. Applications of genetic algorithms.                                                                                          |                                                                                                                                                                                                                   |                         |                           |   |   |             |
| Total Hours                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                   |                         |                           |   |   | 45          |
| Textbooks:                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                   |                         |                           |   |   |             |
| 1                                                                                                                                                                                                                                                                                                                                                | Soft Computing and Machine Learning: A Fuzzy and Neutrosophic View of Reality, Mohd Anas Wajid, Aasim Zafar, Mohammad Saif Wajid, Akib Mohi Ud Din Khanday, Pronaya Bhattacharya, CRC Press, First Edition, 2025. |                         |                           |   |   |             |
| 2                                                                                                                                                                                                                                                                                                                                                | Artificial Neural Networks and Type-2 Fuzzy Set, Snehashish Chakraverty, Arup Kumar Sahoo, Dhabaleswar Mohapatra, Elsevier, First Edition, 2025.                                                                  |                         |                           |   |   |             |
| Reference Books:                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                   |                         |                           |   |   |             |
| 1                                                                                                                                                                                                                                                                                                                                                | New Horizons for Fuzzy Logic Neural Networks and Metaheuristics, Oscar Castillo, Patricia Melin,                                                                                                                  |                         |                           |   |   |             |

|                       |                                                                                                                    |
|-----------------------|--------------------------------------------------------------------------------------------------------------------|
|                       | Springer, First Edition, 2024.                                                                                     |
| 2                     | Soft Computing in Interdisciplinary Sciences, S. Chakraverty, Springer, First Edition, 2022.                       |
| <b>WebReferences:</b> |                                                                                                                    |
| 1                     | NPTEL Course – Fuzzy Logic and Neural Networks <a href="https://nptel.ac.in">https://nptel.ac.in</a>               |
| 2                     | Stanford Online – Machine Learning Resources <a href="https://online.stanford.edu">https://online.stanford.edu</a> |

| Assessment based on Continuous and End Semester Examination |                       |                |                      |            |            |                          |
|-------------------------------------------------------------|-----------------------|----------------|----------------------|------------|------------|--------------------------|
| BLOOM'S TAXONOMY LEVEL                                      | CONTINUOUS ASSESSMENT |                |                      | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6 Marks)        | CIA2 (6 Marks) | Model Exam (8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                |                      |            |            |                          |
| Understand                                                  | 60                    | 40             | 40                   |            |            |                          |
| Apply                                                       | 40                    | 60             | 60                   |            |            |                          |
| Analyze                                                     |                       |                |                      |            |            |                          |
| Evaluate                                                    |                       |                |                      |            |            |                          |
| Create                                                      |                       |                |                      |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>       | <b>8</b>             | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PS01 | PS02 |
|-------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|------|------|
| C610.1      | 3    | 2   | 2   | 1   | 1   | 1   | 0   | 0   | 0   | 0     | 2     | 2    | 1    |
| C610.2      | 3    | 3   | 3   | 2   | 2   | 1   | 2   | 2   | 1   | 0     | 3     | 3    | 2    |
| C610.3      | 2    | 2   | 2   | 1   | 1   | 1   | 0   | 0   | 0   | 0     | 2     | 2    | 1    |
| C610.4      | 3    | 3   | 3   | 2   | 2   | 2   | 2   | 2   | 1   | 1     | 3     | 3    | 2    |
| C610.5      | 3    | 3   | 3   | 3   | 3   | 2   | 2   | 2   | 2   | 1     | 3     | 3    | 3    |

1-low, 2-medium, 3-high, '-'-no correlation

| Course Code                                                                                                                                                                                                                                                                                                            | Course Name                                                                                                          | Category               | Hours/Week                |   |             | C    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-------------|------|
|                                                                                                                                                                                                                                                                                                                        |                                                                                                                      |                        | L                         | T | P           |      |
| 24OE611                                                                                                                                                                                                                                                                                                                | DATABASE FUNDAMENTALS                                                                                                | OE                     | 3                         | 0 | 0           | 3    |
| Regulation                                                                                                                                                                                                                                                                                                             | Nature of the Course                                                                                                 | Semester               | Data Book/Codes/Standards |   |             |      |
| 2024                                                                                                                                                                                                                                                                                                                   | THEORY                                                                                                               | -                      | -----                     |   |             |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                |                                                                                                                      | Co-requisite Course(s) |                           |   |             |      |
| -                                                                                                                                                                                                                                                                                                                      |                                                                                                                      | -                      |                           |   |             |      |
| Course Objectives                                                                                                                                                                                                                                                                                                      |                                                                                                                      |                        |                           |   |             |      |
| 1                                                                                                                                                                                                                                                                                                                      | To learn the fundamentals of data models, relational algebra and SQL                                                 |                        |                           |   |             |      |
| 2                                                                                                                                                                                                                                                                                                                      | To represent a database system using ER diagrams and to learn normalization techniques                               |                        |                           |   |             |      |
| 3                                                                                                                                                                                                                                                                                                                      | To have an introductory knowledge about the Distributed databases, NOSQL and database security                       |                        |                           |   |             |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                        |                                                                                                                      |                        |                           |   |             |      |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                          |                                                                                                                      |                        |                           |   |             |      |
| OE611.1                                                                                                                                                                                                                                                                                                                | To understand basics of Databases                                                                                    |                        |                           |   |             | [U]  |
| OE611.2                                                                                                                                                                                                                                                                                                                | To understand basics of Relational Databases                                                                         |                        |                           |   |             | [U]  |
| OE611.3                                                                                                                                                                                                                                                                                                                | To design database using ER model and normalize the database                                                         |                        |                           |   |             | [AP] |
| OE611.4                                                                                                                                                                                                                                                                                                                | To apply database concepts on distributed Databases                                                                  |                        |                           |   |             | [AP] |
| OE611.5                                                                                                                                                                                                                                                                                                                | To apply database concepts on Database Security                                                                      |                        |                           |   |             | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                        |                                                                                                                      |                        |                           |   |             |      |
| Unit-1                                                                                                                                                                                                                                                                                                                 | Introduction                                                                                                         |                        |                           |   | C01         | 8    |
| Introduction to Databases - Database Models- Components of a DBMS-Types of Databases-Purpose of Database System - Views of data - Data Models - Database System Architecture - Applications of Databases                                                                                                               |                                                                                                                      |                        |                           |   |             |      |
| Unit-2                                                                                                                                                                                                                                                                                                                 | Relational Databases                                                                                                 |                        |                           |   | C02         | 10   |
| Introduction to relational databases - Relational Model - Keys -Relational Algebra-SQL fundamentals- Advanced SQL features - Embedded SQL-Dynamic SQL                                                                                                                                                                  |                                                                                                                      |                        |                           |   |             |      |
| Unit-3                                                                                                                                                                                                                                                                                                                 | Database Design                                                                                                      |                        |                           |   | C03         | 9    |
| Entity-Relationship model - E-R Diagrams-Enhanced-ER Model -ER-to-Relational Mapping-Functional Dependencies - Non-loss Decomposition - First, Second, Third Normal Forms, Dependency Preservation- Boyce/Codd Normal Form - Multi-valued Dependencies and Fourth Normal Form- Join Dependencies and Fifth Normal Form |                                                                                                                      |                        |                           |   |             |      |
| Unit-4                                                                                                                                                                                                                                                                                                                 | Distributed Databases                                                                                                |                        |                           |   | C04         | 9    |
| Architecture, Data Storage, Transaction Processing, Query processing and optimization- NOSQL Databases: Introduction - CAP Theorem - Document Based systems - Key value Stores - Column Based Systems- Graph Databases                                                                                                 |                                                                                                                      |                        |                           |   |             |      |
| Unit-5                                                                                                                                                                                                                                                                                                                 | Database Security                                                                                                    |                        |                           |   | C05         | 9    |
| Security issues - Access control based on privileges - Role Based access control -SQL Injection - Statistical Database security - Flow control - Encryption and Public Key infrastructures-Challenges                                                                                                                  |                                                                                                                      |                        |                           |   |             |      |
|                                                                                                                                                                                                                                                                                                                        |                                                                                                                      |                        |                           |   | Total Hours | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                             |                                                                                                                      |                        |                           |   |             |      |
| 1                                                                                                                                                                                                                                                                                                                      | Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2020. |                        |                           |   |             |      |
| 2                                                                                                                                                                                                                                                                                                                      | Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2017     |                        |                           |   |             |      |
| Reference Books:                                                                                                                                                                                                                                                                                                       |                                                                                                                      |                        |                           |   |             |      |
| 1                                                                                                                                                                                                                                                                                                                      | C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.   |                        |                           |   |             |      |

|                       |                                                                                                                                                           |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2                     | Thomas Connolly, Carolyn Begg, "Database Systems: A Practical Approach to Design, Implementation and Management", Sixth Edition, Pearson Education, 2015. |
| 3                     | Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom, "Database Systems: The Complete Book", Second Edition, Pearson Education, 2009.                  |
| <b>WebReferences:</b> |                                                                                                                                                           |
| 1.                    | <a href="https://nptel.ac.in/courses/106104135">https://nptel.ac.in/courses/106104135</a>                                                                 |
| 2.                    | <a href="https://onlinecourses.nptel.ac.in/noc22_cs91/preview">https://onlinecourses.nptel.ac.in/noc22_cs91/preview</a>                                   |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |                          |                          |                                        |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|--------------------------|--------------------------|----------------------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment<br>(10 Marks) | Attendance<br>(10 Marks) | End Semester Examination<br>(60 Marks) |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |                          |                          |                                        |
| Remember                                                    |                       |                   |                         | 10                       | 10                       | 60                                     |
| Understand                                                  | 100                   | 60                | 80                      |                          |                          |                                        |
| Apply                                                       |                       | 40                | 20                      |                          |                          |                                        |
| Analyze                                                     |                       |                   |                         |                          |                          |                                        |
| Evaluate                                                    |                       |                   |                         |                          |                          |                                        |
| Create                                                      |                       |                   |                         |                          |                          |                                        |
| <b>Total(100 Marks)</b>                                     | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>                | <b>10</b>                | <b>60</b>                              |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| OE611.1     | 3    | 2    | 1    | 1    | 1    | -    | -    | -    | -    | -     | 1     | 2     | 1     | 1     |
| OE611.2     | 3    | 2    | 1    | 1    | 2    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 2     |
| OE611.3     | 3    | 2    | 3    | 1    | 2    | -    | -    | -    | -    | -     | 1     | 3     | 2     | 3     |
| OE611.4     | 3    | 3    | 2    | 2    | 3    | -    | -    | -    | -    | -     | 2     | 2     | 3     | 3     |
| OE611.5     | 2    | 2    | 2    | 1    | 2    | -    | -    | -    | -    | -     | 1     | 2     | 3     | 2     |

| Course Code                                                                                                                                                                                                                                                                             | CourseName                                                                                                                           | Category              | Hours/Week               |   |            | C    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|------------|------|
|                                                                                                                                                                                                                                                                                         |                                                                                                                                      |                       | L                        | T | P          |      |
| 24OE612                                                                                                                                                                                                                                                                                 | BASICSOFIMAGEPROCESSING                                                                                                              | OE                    | 3                        | 0 | 0          | 3    |
| Regulation                                                                                                                                                                                                                                                                              | NatureoftheCourse                                                                                                                    | Semester              | DataBook/Codes/Standards |   |            |      |
| 2024                                                                                                                                                                                                                                                                                    | THEORY                                                                                                                               | -                     | -----                    |   |            |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                  |                                                                                                                                      | Co-requisiteCourse(s) |                          |   |            |      |
| -                                                                                                                                                                                                                                                                                       |                                                                                                                                      | -                     |                          |   |            |      |
| CourseObjectives                                                                                                                                                                                                                                                                        |                                                                                                                                      |                       |                          |   |            |      |
| 1                                                                                                                                                                                                                                                                                       | To become familiar with digital image fundamentals.                                                                                  |                       |                          |   |            |      |
| 2                                                                                                                                                                                                                                                                                       | To get exposed to simple image enhancement techniques in Spatial and Frequency domain.                                               |                       |                          |   |            |      |
| 3                                                                                                                                                                                                                                                                                       | To learn concepts of degradation function and restoration techniques.                                                                |                       |                          |   |            |      |
| 4                                                                                                                                                                                                                                                                                       | To study the image segmentation and representation techniques.                                                                       |                       |                          |   |            |      |
| 5                                                                                                                                                                                                                                                                                       | To become familiar with image compression and recognition methods                                                                    |                       |                          |   |            |      |
| CourseOutcomes                                                                                                                                                                                                                                                                          |                                                                                                                                      |                       |                          |   |            |      |
| Uponcompletionofthecourse,studentsshallhaveabilityto                                                                                                                                                                                                                                    |                                                                                                                                      |                       |                          |   |            |      |
| OE612.1                                                                                                                                                                                                                                                                                 | To understand the basics and fundamentals ofdigital image processing, such asdigitization, sampling, quantization, and 2D-transforms |                       |                          |   |            | [U]  |
| OE612.2                                                                                                                                                                                                                                                                                 | To understand on images using the techniques ofsmoothing, sharpening andenhancement                                                  |                       |                          |   |            | [U]  |
| OE612.3                                                                                                                                                                                                                                                                                 | To apply the restoration concepts and filtering techniques.                                                                          |                       |                          |   |            | [AP] |
| OE612.4                                                                                                                                                                                                                                                                                 | To learn the basics ofsegmentation methods                                                                                           |                       |                          |   |            | [AP] |
| OE612.5                                                                                                                                                                                                                                                                                 | To Comprehend compression and recognition concepts.                                                                                  |                       |                          |   |            | [AP] |
| CourseContents                                                                                                                                                                                                                                                                          |                                                                                                                                      |                       |                          |   |            |      |
| Unit-1                                                                                                                                                                                                                                                                                  | DIGITALIMAGEFUNDAMENTALS                                                                                                             |                       |                          |   | C01        | 10   |
| Steps in Digital Image Processing – Components – ElementsofVisualPerception–ImageSensing and Acquisition – Image Sampling and Quantization – Relationships between pixels -Color image fundamentals- RGB, HSImodels, Two-dimensionalmathematicalpreliminaries, 2Dtransforms- DFT, DCT.  |                                                                                                                                      |                       |                          |   |            |      |
| Unit-2                                                                                                                                                                                                                                                                                  | IMAGEENHANCEMENT                                                                                                                     |                       |                          |   | C02        | 8    |
| Gray level transformations – Histogram processing – Basics of Spatial Filtering, Frequency Domain: Introductionto Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth andGaussian filters                                                         |                                                                                                                                      |                       |                          |   |            |      |
| Unit-3                                                                                                                                                                                                                                                                                  | IMAGERESTORATION                                                                                                                     |                       |                          |   | C03        | 9    |
| Image Restoration - degradation model, Properties, Noise models – MeanFilters– OrderStatistics– Adaptivefilters – BandrejectFilters – BandpassFilters –NotchFilters                                                                                                                     |                                                                                                                                      |                       |                          |   |            |      |
| Unit-4                                                                                                                                                                                                                                                                                  | IMAGESEGMENTATION                                                                                                                    |                       |                          |   | C04        | 9    |
| Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation – Regiongrowing– Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts.                                  |                                                                                                                                      |                       |                          |   |            |      |
| Unit-5                                                                                                                                                                                                                                                                                  | IMAGECOMPRESSIONANDRECOGNITION                                                                                                       |                       |                          |   | C05        | 9    |
| Needfordatacompression, Huffman, RunLengthEncoding,Shiftcodes, Arithmeticcoding, JPEGstandard,MPEG.Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topologicalfeature,Texture - Patterns and Pattern classes - Recognition based on matching. |                                                                                                                                      |                       |                          |   |            |      |
|                                                                                                                                                                                                                                                                                         |                                                                                                                                      |                       |                          |   | TotalHours | 45   |
| Textbooks:                                                                                                                                                                                                                                                                              |                                                                                                                                      |                       |                          |   |            |      |
| 1                                                                                                                                                                                                                                                                                       | AbrahamSilberschatz, HenryF. Korth, S. Sudharshan, “DatabaseSystemConcepts”,Seventh Edition, McGraw Hill,2020.                       |                       |                          |   |            |      |
| 2                                                                                                                                                                                                                                                                                       | Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Seventh Edition,Pearson Education, 2017                      |                       |                          |   |            |      |
| ReferenceBooks:                                                                                                                                                                                                                                                                         |                                                                                                                                      |                       |                          |   |            |      |
| 1                                                                                                                                                                                                                                                                                       | C.J.Date, A.Kannan, S.Swamynathan, “AnIntroductiontoDatabaseSystems”, EighthEdition,PearsonEducation, 2006.                          |                       |                          |   |            |      |
| 2                                                                                                                                                                                                                                                                                       | RafaelC. Gonzalez, RichardE. Woods, “DigitalImageProcessing”,FourthEdition,Pearson Education. 2018.                                  |                       |                          |   |            |      |

|                        |                                                                                                                           |
|------------------------|---------------------------------------------------------------------------------------------------------------------------|
| 3                      | Anil K. Jain, "Fundamentals of Digital Image Processing", First Edition, Prentice Hall, 1989.                             |
| <b>Web References:</b> |                                                                                                                           |
| 1.                     | <a href="https://onlinecourses.nptel.ac.in/noc22_ee116/preview">https://onlinecourses.nptel.ac.in/noc22_ee116/preview</a> |
| 2.                     | <a href="https://onlinecourses.nptel.ac.in/noc26_ee31/preview">https://onlinecourses.nptel.ac.in/noc26_ee31/preview</a>   |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |                          |                          |                                        |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|--------------------------|--------------------------|----------------------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment<br>(10 Marks) | Attendance<br>(10 Marks) | End Semester Examination<br>(60 Marks) |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |                          |                          |                                        |
| Remember                                                    |                       |                   |                         | 10                       | 10                       | 60                                     |
| Understand                                                  | 100                   | 60                | 80                      |                          |                          |                                        |
| Apply                                                       |                       | 40                | 20                      |                          |                          |                                        |
| Analyze                                                     |                       |                   |                         |                          |                          |                                        |
| Evaluate                                                    |                       |                   |                         |                          |                          |                                        |
| Create                                                      |                       |                   |                         |                          |                          |                                        |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>                | <b>10</b>                | <b>60</b>                              |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| OE612       | 3    | 2    | 1    | 1    | 1    | -    | -    | -    | -    | -     | 1     | 2     | 1     | 1     |
| OE612       | 3    | 2    | 1    | 1    | 2    | -    | -    | -    | -    | -     | 1     | 2     | 2     | 2     |
| OE612       | 3    | 3    | 2    | 2    | 3    | -    | -    | -    | -    | -     | 2     | 2     | 3     | 3     |
| OE612       | 3    | 3    | 2    | 2    | 2    | -    | -    | -    | -    | -     | 2     | 2     | 3     | 3     |
| OE612       | 2    | 2    | 2    | 1    | 2    | -    | -    | -    | -    | -     | 2     | 2     | 3     | 2     |

| Course Code                                                                                                                                                                                                                                                                                         | CourseName                                                                                                                                       | Category              | Hours/Week               |   |   | C    |   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|---|------|---|
|                                                                                                                                                                                                                                                                                                     |                                                                                                                                                  |                       | L                        | T | P |      |   |
| 24OE613                                                                                                                                                                                                                                                                                             | VEHICULARADHOCNETWORKS                                                                                                                           | OE                    | 3                        | 0 | 0 | 3    |   |
| Regulation                                                                                                                                                                                                                                                                                          | Nature ofthe Course                                                                                                                              | Semester              | DataBook/Codes/Standards |   |   |      |   |
| 2024                                                                                                                                                                                                                                                                                                | THEORY                                                                                                                                           | -                     | -----                    |   |   |      |   |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                              |                                                                                                                                                  | Co-requisiteCourse(s) |                          |   |   |      |   |
| -                                                                                                                                                                                                                                                                                                   |                                                                                                                                                  | -                     |                          |   |   |      |   |
| CourseObjectives                                                                                                                                                                                                                                                                                    |                                                                                                                                                  |                       |                          |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                   | ToteachthestudentsconceptsofVANET.                                                                                                               |                       |                          |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                   | To understand about Message forwarding and Challenges ofvehicular systems                                                                        |                       |                          |   |   |      |   |
| 3                                                                                                                                                                                                                                                                                                   | To understand implementation scope, applications and case studies ofVANET.                                                                       |                       |                          |   |   |      |   |
| CourseOutcomes                                                                                                                                                                                                                                                                                      |                                                                                                                                                  |                       |                          |   |   |      |   |
| Uponcompletionofthecourse,studentsshallhaveabilityto                                                                                                                                                                                                                                                |                                                                                                                                                  |                       |                          |   |   |      |   |
| OE613.1                                                                                                                                                                                                                                                                                             | TounderstandVANETBasics                                                                                                                          |                       |                          |   |   | [U]  |   |
| OE613.2                                                                                                                                                                                                                                                                                             | To comprehend the message forwarding strategies.                                                                                                 |                       |                          |   |   | [U]  |   |
| OE613.3                                                                                                                                                                                                                                                                                             | TounderstandthechallengesinVANET                                                                                                                 |                       |                          |   |   | [U]  |   |
| OE613.4                                                                                                                                                                                                                                                                                             | To apply VANET in different services and to understand through simulation                                                                        |                       |                          |   |   | [AP] |   |
| OE613.5                                                                                                                                                                                                                                                                                             | ToapplyVANETconceptsindifferentapplications                                                                                                      |                       |                          |   |   | [AP] |   |
| CourseContents                                                                                                                                                                                                                                                                                      |                                                                                                                                                  |                       |                          |   |   |      |   |
| Unit-1                                                                                                                                                                                                                                                                                              | INTRODUCTIONTOVANET                                                                                                                              |                       |                          |   |   | C01  | 9 |
| VANET Basics – Scenarios – Components ofVANET-NeedandCharacteristicsofVANET–Communicationin VANET: Types, IntroductiontoDSRC : IEEE 1609.0,1609.1,1609.2,1609.3,1609.4,IEEE802.11P–Physicaland MAC layer.                                                                                           |                                                                                                                                                  |                       |                          |   |   |      |   |
| Unit-2                                                                                                                                                                                                                                                                                              | MESSAGINGFORWARDINGSTRATEGIES                                                                                                                    |                       |                          |   |   | C02  | 9 |
| Types of messages in VANET, Message Forwarding Strategies, Message Packet Format, Need of Priority-BasedMessage Forwarding, Priority assigning mechanism,                                                                                                                                           |                                                                                                                                                  |                       |                          |   |   |      |   |
| Unit-3                                                                                                                                                                                                                                                                                              | CHALLENGESINVANET                                                                                                                                |                       |                          |   |   | C03  | 9 |
| Challenges: Volatility, Critical Time latency, Diverse networking standards, High Mobility of nodes, NetworkSecurity, Efficient Message forwarding, Mitigation Techniques to address VANET Security                                                                                                 |                                                                                                                                                  |                       |                          |   |   |      |   |
| Unit-4                                                                                                                                                                                                                                                                                              | SCOPEANDAPPLICATIONOFVANET                                                                                                                       |                       |                          |   |   | C04  | 9 |
| ScopeofVANET, ApplicationofVANET, TrafficManagement, User-OrientedServices, ConvenienceServices, PotentialProjects, ToolsandSimulationPlatformofVANET, Conclusions– VANETandIntelligentTransportation System                                                                                        |                                                                                                                                                  |                       |                          |   |   |      |   |
| Unit-5                                                                                                                                                                                                                                                                                              | CASESTUDIES                                                                                                                                      |                       |                          |   |   | C05  | 9 |
| Learning-BasedRogueEdgeDetectioninVANETswithAmbientRadioSignals, LearningWhileOffloading: Task Offloading in Vehicular Edge Computing Network, Intelligent Network Access System for Vehicular Real-TimeService Provisioning, UAV Relay in VANETs Against Smart Jamming with Reinforcement Learning |                                                                                                                                                  |                       |                          |   |   |      |   |
| TotalHours                                                                                                                                                                                                                                                                                          |                                                                                                                                                  |                       |                          |   |   | 45   |   |
| Textbooks:                                                                                                                                                                                                                                                                                          |                                                                                                                                                  |                       |                          |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                   | Botkar, SonaliP., etal. VANET: challengesandopportunities. CRCPress,2021.                                                                        |                       |                          |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                   | Xiao, Liang, et al. Learning-based VANET communication and security techniques. Springer InternationalPublishing, 2019.                          |                       |                          |   |   |      |   |
| 3                                                                                                                                                                                                                                                                                                   | Hartenstein, Hannes, and Kenneth Laberteaux, eds. VANET: vehicular applications and inter- networkingtechnologies. JohnWiley&Sons, 2009.         |                       |                          |   |   |      |   |
| ReferenceBooks:                                                                                                                                                                                                                                                                                     |                                                                                                                                                  |                       |                          |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                   | IntelligentVehicleTechnologiesTheoryandAppications– LVLacic, MParent,FHarashima - Butterworth Heinemann, 2015                                    |                       |                          |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                   | Scorer, A. "VehicleLocationandNavigationSystems. ByYilinZhao. ArtechHouse,1997.ISBN:0-89006-861-5." TheJournalofNavigation 51.3 (1998): 445-447. |                       |                          |   |   |      |   |
| WebReferences:                                                                                                                                                                                                                                                                                      |                                                                                                                                                  |                       |                          |   |   |      |   |
| 1.                                                                                                                                                                                                                                                                                                  | https://onlinecourses.nptel.ac.in/noc26_cs51/preview                                                                                             |                       |                          |   |   |      |   |
| 2.                                                                                                                                                                                                                                                                                                  | https://nptel.ac.in/courses/106105160                                                                                                            |                       |                          |   |   |      |   |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |                          |                          |                                        |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|--------------------------|--------------------------|----------------------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment<br>(10 Marks) | Attendance<br>(10 Marks) | End Semester Examination<br>(60 Marks) |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |                          |                          |                                        |
| Remember                                                    |                       |                   |                         | 10                       | 10                       | 60                                     |
| Understand                                                  | 100                   | 100               | 60                      |                          |                          |                                        |
| Apply                                                       |                       |                   | 40                      |                          |                          |                                        |
| Analyze                                                     |                       |                   |                         |                          |                          |                                        |
| Evaluate                                                    |                       |                   |                         |                          |                          |                                        |
| Create                                                      |                       |                   |                         |                          |                          |                                        |
| <b>Total(100 Marks)</b>                                     | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>                | <b>10</b>                | <b>60</b>                              |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| C0s/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| OE613.1     | 3    | 2    | 1    | 1    | 1    | –    | –    | –    | –    | –     | 1     | 2     | 1     | 1     |
| OE613.2     | 3    | 3    | 1    | 1    | 2    | –    | –    | –    | –    | –     | 1     | 2     | 2     | 2     |
| OE613.3     | 3    | 3    | 1    | 2    | 2    | –    | –    | –    | –    | –     | 2     | 2     | 2     | 2     |
| OE613.4     | 3    | 2    | 3    | 2    | 3    | –    | –    | –    | –    | –     | 2     | 2     | 3     | 3     |
| OE613.5     | 3    | 2    | 3    | 2    | 2    | –    | –    | –    | –    | –     | 2     | 3     | 3     | 3     |

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | CourseName                                                                                                                                             | Category              | Hours/Week               |   |   | C    |   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|---|------|---|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                        |                       | L                        | T | P |      |   |
| 24OE614                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | WEBTECHNOLOGYFUNDAMENTALS                                                                                                                              | OE                    | 3                        | 0 | 0 | 3    |   |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | NatureoftheCourse                                                                                                                                      | Semester              | DataBook/Codes/Standards |   |   |      |   |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | THEORY                                                                                                                                                 | -                     | -----                    |   |   |      |   |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                        | Co-requisiteCourse(s) |                          |   |   |      |   |
| -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                        | -                     |                          |   |   |      |   |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                        |                       |                          |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To understand different Internet Technologies                                                                                                          |                       |                          |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To learn java-specific web services architecture                                                                                                       |                       |                          |   |   |      |   |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To Develop web applications using frameworks                                                                                                           |                       |                          |   |   |      |   |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                        |                       |                          |   |   |      |   |
| Uponcompletionofthecourse,studentsshallhaveabilityto                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                        |                       |                          |   |   |      |   |
| OE614.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | To understand responsive web pages using HTML5 and CSS3                                                                                                |                       |                          |   |   | [U]  |   |
| OE614.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | To build dynamic client-side functionality with JavaScript and DOM manipulation                                                                        |                       |                          |   |   | [AP] |   |
| OE614.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | To implement server-side functionality using PHP, Java Servlets, and Node.js.                                                                          |                       |                          |   |   | [AP] |   |
| OE614.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | To create and connect web applications to databases using JDBC and MySQL                                                                               |                       |                          |   |   | [AP] |   |
| OE614.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | To understand and apply modern frameworks like Angular, React, and Django for full-stack web development.                                              |                       |                          |   |   | [AP] |   |
| CourseContents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                        |                       |                          |   |   |      |   |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | FUNDAMENTALSOFWEBTECHNOLOGIES                                                                                                                          |                       |                          |   |   | C01  | 9 |
| Web Essentials: Understanding Clients, Servers, and Communication - InternetFundamentals: World Wide Web -HTTP Request and Response Messages- HTML5:Introduction toHTML5Tags,Tables,Lists,andImages-HTML5 ControlElements: Forms,InputTypes,DragandDrop, Audio,andVideo- CSS3:Inline,Embedded,andExternal Stylesheets - RuleCascadingandInheritanceinCSS3 - CSS3Transitions,Animations&Transformations -Bootstrap Framework: Using the Bootstrap Grid System, Responsive Design Principles, and Components |                                                                                                                                                        |                       |                          |   |   |      |   |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | CLIENT-SIDEPROGRAMMING                                                                                                                                 |                       |                          |   |   | C02  | 9 |
| JavaScript: Variables, Functions,Loops, ConditionalStatements-DOMManipulation: SelectingElements, ModifyingContentandAttributes- ExceptionHandling: Try- CatchBlocks,ThrowingCustomErrors-FormValidation: UsingJavaScripttoValidateUserInput -DHTMLwithJavaScript: CreatingDynamicWebPages- JSON:Parsing JSON.                                                                                                                                                                                             |                                                                                                                                                        |                       |                          |   |   |      |   |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | SERVER-SIDEPROGRAMMING                                                                                                                                 |                       |                          |   |   | C03  | 9 |
| Java Servlet Technology: Servlet Architecture and Lifecycle - Handling HTTP Requests andSessions:Form GET/POST, Cookies, URL Rewriting- JDBC: Connecting to Databases,PerformingCRUDOperations- AdvancedJava Concepts: IntroductiontoJSPArchitecture - DatabaseConnectivity: MySQL, SQLite.                                                                                                                                                                                                                |                                                                                                                                                        |                       |                          |   |   |      |   |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | PHPANDXML                                                                                                                                              |                       |                          |   |   | C04  | 9 |
| PHPBasics: Syntax, Variables, Operators, DataTypes, Conditionals, Arrays, Functions, FormHandling, and Validation - XML Basics: Understanding XML Structure, DTD,and XMLSchemas-XMLParsing:UsingDOMandSAX ParsersinPHP.                                                                                                                                                                                                                                                                                    |                                                                                                                                                        |                       |                          |   |   |      |   |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | MODERNWEBAPPLICATIONFRAMEWORKS                                                                                                                         |                       |                          |   |   | C05  | 9 |
| IntroductiontoAngularJSandAngular2+:MVCArchitecture,Components,Directives-AngularDataBinding: Expressions, ngModel, ng-repeat - ReactBasics: Component-BasedArchitecture, JSX, Props, State- Node.jsBasics:Event-driven, Non-blocking I/O, Server-Side JavaScript -Express Framework: Building RESTful APIs with Express andNode.js - DjangoFramework: MVC/MVTArchitecture, PythoninWebApps.                                                                                                               |                                                                                                                                                        |                       |                          |   |   |      |   |
| TotalHours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                        |                       |                          |   |   | 45   |   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                        |                       |                          |   |   |      |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Harvey, HarveyDeitel, andAbbeyDeitel. "InternetandWorldWideWebHowToProgram."(2011).                                                                    |                       |                          |   |   |      |   |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Jeffrey, C. "Jackson,"WebTechnologiesAComputerSciencePerspective". " (2011).                                                                           |                       |                          |   |   |      |   |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Uluca, Doguhan. Angular 6 for Enterprise-Ready Web Applications: Deliver production-readyand cloud-scale Angular web apps. Packt Publishing Ltd, 2018. |                       |                          |   |   |      |   |
| ReferenceBooks:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                        |                       |                          |   |   |      |   |

|                        |                                                                                                                                                   |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                      | Stephen Wynkoop and John Burke "Running a Perfect Website", QUE, 2nd Edition, 1999                                                                |
| 2                      | Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley Publications, 2009.                                             |
| 3                      | Gopalan N.P. and Akilandeswari J., "Web Technology", Prentice Hall of India, 2011                                                                 |
| <b>Web References:</b> |                                                                                                                                                   |
| 1.                     | <a href="https://onlinecourses.swayam2.ac.in/e-learning/preview/nou24_cs09">https://onlinecourses.swayam2.ac.in/e-learning/preview/nou24_cs09</a> |
| 2.                     | <a href="https://onlinecourses.swayam2.ac.in/e-learning/preview/nou23_cs03">https://onlinecourses.swayam2.ac.in/e-learning/preview/nou23_cs03</a> |

| <b>Assessment based on Continuous and End Semester Examination</b> |                              |                           |                                 |                                  |                                  |                                                |
|--------------------------------------------------------------------|------------------------------|---------------------------|---------------------------------|----------------------------------|----------------------------------|------------------------------------------------|
| <b>Bloom's Level</b>                                               | <b>Continuous Assessment</b> |                           |                                 | <b>Assignment<br/>(10 Marks)</b> | <b>Attendance<br/>(10 Marks)</b> | <b>End Semester Examination<br/>(60 Marks)</b> |
|                                                                    | <b>CIA1<br/>(6 Marks)</b>    | <b>CIA2<br/>(6 Marks)</b> | <b>Model Exam<br/>(8 Marks)</b> |                                  |                                  |                                                |
| Remember                                                           |                              |                           |                                 | <b>10</b>                        | <b>10</b>                        | <b>60</b>                                      |
| Understand                                                         | 80                           | 100                       | 20                              |                                  |                                  |                                                |
| Apply                                                              | 20                           |                           | 80                              |                                  |                                  |                                                |
| Analyze                                                            |                              |                           |                                 |                                  |                                  |                                                |
| Evaluate                                                           |                              |                           |                                 |                                  |                                  |                                                |
| Create                                                             |                              |                           |                                 | <b>10</b>                        | <b>10</b>                        | <b>60</b>                                      |
| <b>Total (100 Marks)</b>                                           | <b>6</b>                     | <b>6</b>                  | <b>8</b>                        |                                  |                                  |                                                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| <b>COs/<br/>POs</b> | <b>PO 1</b> | <b>PO 2</b> | <b>PO 3</b> | <b>PO 4</b> | <b>PO 5</b> | <b>PO 6</b> | <b>PO 7</b> | <b>PO 8</b> | <b>PO 9</b> | <b>PO 10</b> | <b>PO 11</b> | <b>PSO 1</b> | <b>PSO 2</b> | <b>PSO 3</b> |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|
| OE614.1             | 3           | 2           | 3           | 1           | 3           | –           | –           | –           | –           | –            | 1            | 2            | 2            | 3            |
| OE614.2             | 3           | 3           | 2           | 2           | 3           | –           | –           | –           | –           | –            | 1            | 2            | 3            | 3            |
| OE614.3             | 3           | 3           | 3           | 2           | 3           | –           | –           | –           | –           | –            | 2            | 3            | 3            | 3            |
| OE614.4             | 3           | 3           | 3           | 2           | 3           | –           | –           | –           | –           | –            | 2            | 3            | 3            | 3            |
| OE614.5             | 3           | 2           | 3           | 2           | 3           | –           | –           | –           | –           | –            | 3            | 3            | 3            | 3            |

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                              | CourseName                                                                                                               | Category              | Hours/Week               |   |            | C    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|------------|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                          |                       | L                        | T | P          |      |
| 24OE615                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | APPDEVELOPMENTFUNDAMENTALS                                                                                               | OE                    | 3                        | 0 | 0          | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                                               | NatureoftheCourse                                                                                                        | Semester              | DataBook/Codes/Standards |   |            |      |
| 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | THEORY                                                                                                                   | -                     | -----                    |   |            |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                          | Co-requisiteCourse(s) |                          |   |            |      |
| -                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                          | -                     |                          |   |            |      |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                          |                       |                          |   |            |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | To learn development ofnative applications with basic GUI Components                                                     |                       |                          |   |            |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | To develop cross-platform applications with event handling                                                               |                       |                          |   |            |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | To develop applications with location and data storage capabilities                                                      |                       |                          |   |            |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | To develop web applications with database access                                                                         |                       |                          |   |            |      |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                          |                       |                          |   |            |      |
| Uponcompletionofthecourse,studentsshallhaveabilityto                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                          |                       |                          |   |            |      |
| OE615.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | To understand various mobile app development model.                                                                      |                       |                          |   |            | [U]  |
| OE615.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | To design simple native and cross-platform mobile applications                                                           |                       |                          |   |            | [AP] |
| OE615.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | To apply frameworks such as React Native and Ionic effectively                                                           |                       |                          |   |            | [AP] |
| OE615.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | To evaluate frameworks based on performance and development needs                                                        |                       |                          |   |            | [AP] |
| OE615.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | To understand app deployment, debugging, and maintenance fundamentals                                                    |                       |                          |   |            | [AP] |
| CourseContents                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                          |                       |                          |   |            |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | FUNDAMENTALSOFWEBANDMOBILEAPPLICATIONDEVELOPMENT                                                                         |                       |                          |   | C01        | 9    |
| Introduction to mobile and web app ecosystems -Native apps – architecture and characteristics - Hybrid apps –architecture and use cases - Cross-platform apps – concept and use cases- Progressive Web Apps (PWA) – functionality and offline capabilities- Responsive Web Design – fluid layouts, media queries, flexible grids.                                                                                                                                        |                                                                                                                          |                       |                          |   |            |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | NATIVEAPPDEVELOPMENT                                                                                                     |                       |                          |   | C02        | 9    |
| NativeAndroid development – Java and Kotlin basics - Native iOS development – Swift and Objective-C overview -AndroidStudioandXcode–IDEwalkthrough- Activitylifecycle, Views,andUIcomponents- Permissions,localstorage,andappmanifestconfiguration-IntroductiontoGradlebuildprocess- PlayStoreandAppStore–submission basics and guidelines.                                                                                                                              |                                                                                                                          |                       |                          |   |            |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | HYBRIDAPPDEVELOPMENT                                                                                                     |                       |                          |   | C03        | 9    |
| Hybridappstructure – HTML, CSS, JavaScriptwithWebView – ApacheCordova– pluginsandnativeaccess-Ionic framework–Ultoolkitandcomponentstructure-Integrationwithdevicefeatures–camera,GPS,storage-Debugging and testing hybrid apps on emulators and devices - Performance considerations and offline support- Enterprise applications – hybrid use cases.                                                                                                                   |                                                                                                                          |                       |                          |   |            |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | CROSS-PLATFORMAPPDEVELOPMENT                                                                                             |                       |                          |   | C04        | 9    |
| Cross-platformframeworks – needandcomparison - ReactNative – components, JSX,props,state-Flutter–Dart basics, widgets, state management -Navigation and routing in mobile apps - Hot reload and debugging techniques-Platform-specific code in cross-platform apps - Integration with REST APIs and Firebase – Overview.                                                                                                                                                 |                                                                                                                          |                       |                          |   |            |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | NON-FUNCTIONALASPECTSANDDEPLOYMENTSTRATEGIES                                                                             |                       |                          |   | C05        | 9    |
| Framework comparison – performance, flexibility, and scalability - App performance – rendering, responsiveness,startuptime - Debuggingandprofilingtools – AndroidDebugBridge, FlutterDevTools,ReactDevTools- Time-to-market and maintainability- UI/UX consistency– MaterialDesign,HumanInterfaceGuidelines-CI/CDpipelines– GitHub Actions, Fastlane - Version control, build automation, and testing workflows - Basics ofanalytics, crashreporting, and user feedback. |                                                                                                                          |                       |                          |   |            |      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                          |                       |                          |   | TotalHours | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                          |                       |                          |   |            |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Griffiths, Dawn, and David Griffiths. Head first android development: a brain-friendly guide."O'ReillyMedia, Inc.",2017. |                       |                          |   |            |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Camden, RaymondK. ApacheCordovainaction. SimonandSchuster, 2015.                                                         |                       |                          |   |            |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Abbott, Devin, etal. "FullstackReactNative."(2017).                                                                      |                       |                          |   |            |      |
| ReferenceBooks:                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                          |                       |                          |   |            |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Horton, John. Androidprogrammingforbeginners. PacktPublishingLtd, 2015.                                                  |                       |                          |   |            |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Lewis, Shaun, and Mike Dunn. Native mobile development: a cross-reference for iOSand Android                             |                       |                          |   |            |      |

|                        |                                                                                                                                                                |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | O'Reilly Media, 2019.                                                                                                                                          |
| 3                      | Lingras, Rucha, Matt Triff, and Rucha Lingras. Building Cross-Platform Mobile and Web Apps for Engineers and Scientists. Cengage Learning, Incorporated, 2016. |
| 4                      | Wargo, John M. Apache Cordova 4 Programming. Pearson Education, 2015.                                                                                          |
| 5                      | Ward, Dan. React Native Cookbook: Recipes for solving common React Native development problems. Packt Publishing Ltd, 2019.                                    |
| <b>Web References:</b> |                                                                                                                                                                |
| 1.                     | <a href="https://onlinecourses.swayam2.ac.in/e-learning/preview/nou22_ge25">https://onlinecourses.swayam2.ac.in/e-learning/preview/nou22_ge25</a>              |
| 2.                     | <a href="https://onlinecourses.nptel.ac.in/noc20_cs52/preview">https://onlinecourses.nptel.ac.in/noc20_cs52/preview</a>                                        |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |                          |                          |                                        |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|--------------------------|--------------------------|----------------------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment<br>(10 Marks) | Attendance<br>(10 Marks) | End Semester Examination<br>(60 Marks) |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |                          |                          |                                        |
| Remember                                                    |                       |                   |                         | 10                       | 10                       | 60                                     |
| Understand                                                  | 80                    | 100               | 20                      |                          |                          |                                        |
| Apply                                                       | 20                    |                   | 80                      |                          |                          |                                        |
| Analyze                                                     |                       |                   |                         |                          |                          |                                        |
| Evaluate                                                    |                       |                   |                         |                          |                          |                                        |
| Create                                                      |                       |                   |                         | 10                       | 10                       | 60                                     |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                |                          |                          |                                        |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| OE615.1     | 3    | 2    | 1    | 1    | 1    | –    | –    | –    | –    | –     | 1     | 2     | 1     | 1     |
| OE615.2     | 3    | 2    | 3    | 1    | 3    | –    | –    | –    | –    | –     | 1     | 2     | 2     | 3     |
| OE615.3     | 3    | 3    | 2    | 2    | 3    | –    | –    | –    | –    | –     | 2     | 2     | 3     | 3     |
| OE615.4     | 3    | 3    | 2    | 2    | 2    | –    | –    | –    | –    | –     | 2     | 3     | 3     | 2     |
| OE615.5     | 3    | 2    | 2    | 2    | 3    | –    | –    | –    | –    | –     | 3     | 3     | 3     | 3     |

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Course Name                                                                                                          | Category               | Hours/Week                |   |   | C  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                      |                        | L                         | T | P |    |
| 240E616                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Introduction to Augmented Reality / Virtual Reality                                                                  | OE                     | 3                         | 0 | 0 | 3  |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Nature of the Course                                                                                                 | Semester               | Data Book/Codes/Standards |   |   |    |
| R24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | THEORY                                                                                                               | 4                      | -----                     |   |   |    |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                      | Co-requisite Course(s) |                           |   |   |    |
| -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                      | -                      |                           |   |   |    |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                      |                        |                           |   |   |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To impart the fundamental aspects and principles of AR/VR technologies.                                              |                        |                           |   |   |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To know the internal of the hardware and software components involved in the development of AR enabled applications. |                        |                           |   |   |    |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To learn about the graphical processing units and their architectures.                                               |                        |                           |   |   |    |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To gain knowledge about AR/VR application development.                                                               |                        |                           |   |   |    |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To know the technologies involved in the development of AR/VR based applications.                                    |                        |                           |   |   |    |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                      |                        |                           |   |   |    |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                      |                        |                           |   |   |    |
| C616.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Understand the basic concepts of AR and VR.                                                                          |                        |                           |   |   | U  |
| C616.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Understand the hardware tools and technologies related to AR/VR.                                                     |                        |                           |   |   | U  |
| C616.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply the working principle of AR/VR software components related to Sensor devices.                                  |                        |                           |   |   | AP |
| C616.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Design various models using modeling techniques.                                                                     |                        |                           |   |   | AP |
| C616.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Develop AR/VR applications in different domains.                                                                     |                        |                           |   |   | AP |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                      |                        |                           |   |   |    |
| Unit -1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Introduction                                                                                                         |                        |                           |   |   | 9  |
| Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space – Three's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefit of Virtual Reality – Components of VR System – Introduction to AR – AR Technologies – Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System. |                                                                                                                      |                        |                           |   |   |    |
| Unit -2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | VR MODELING                                                                                                          |                        |                           |   |   | 9  |
| Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants – Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.                                                                                                                                                                                                                        |                                                                                                                      |                        |                           |   |   |    |
| Unit -3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | VR PROGRAMMING                                                                                                       |                        |                           |   |   | 9  |
| VR Programming – Toolkits and Scene Graphs – World Tool Kit – Java 3D – Comparison of World Tool Kit and Java 3D.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                      |                        |                           |   |   |    |
| Unit -4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | APPLICATIONS                                                                                                         |                        |                           |   |   | 9  |
| Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society – Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.                                                                                                                                                                                                                       |                                                                                                                      |                        |                           |   |   |    |
| Unit-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | AUGMENTED REALITY                                                                                                    |                        |                           |   |   | 9  |

|                                                                                                                             |                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation Navigation-Wearable devices . |                                                                                                                                    |
| <b>Total Hours</b>                                                                                                          |                                                                                                                                    |
| <b>45</b>                                                                                                                   |                                                                                                                                    |
| <b>Textbooks:</b>                                                                                                           |                                                                                                                                    |
| 1                                                                                                                           | Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018. |
| 2                                                                                                                           | Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016.                             |
| <b>Reference Books:</b>                                                                                                     |                                                                                                                                    |
| 1                                                                                                                           | John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.                                                              |
| 2                                                                                                                           | William R. Sherman, Alan B. Craig: "Understanding Virtual Reality-Interface, Application, Design", Morgan Kaufmann, 2003           |
| <b>Web References:</b>                                                                                                      |                                                                                                                                    |
| 1                                                                                                                           | <a href="https://en.wikipedia.org/wiki/Augmented_reality">https://en.wikipedia.org/wiki/Augmented_reality</a>                      |
| 2                                                                                                                           | <a href="https://developers.google.com/ar">https://developers.google.com/ar</a>                                                    |
| 3                                                                                                                           | <a href="https://unity.com/unity/features/arfoundation">https://unity.com/unity/features/arfoundation</a>                          |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                                                    |                       |                   |                         | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand                                                  | 100                   | 20%               | 40%                     |            |            |                          |
| Apply                                                       |                       | 80%               | 60%                     |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PO<br>12 | PSO<br>1 | PSO<br>2 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|
| C616.1      | 3       | 2       | 2       | -       | 3       | -       | -       | -       | 2       | 2        | 1        | 2        | 2        | 1        |
| C616.2      | 3       | 2       | 2       | 1       | 3       | -       | -       | -       | 3       | 2        | 2        | 3        | 3        | 1        |
| C616.3      | 3       | 3       | 2       | 2       | 3       | -       | -       | -       | 3       | 2        | 1        | 2        | 3        | 2        |
| C616.4      | 3       | 3       | 3       | 2       | 3       | -       | -       | -       | 3       | 2        | 2        | 3        | 3        | 2        |
| C616.5      | 3       | 3       | 3       | 3       | 3       | -       | -       | -       | 3       | 3        | 3        | 3        | 3        | 3        |

3 - High 2 - Medium 1 - Low

-- no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                                                   | Course Name                                                                                       | Category               | Hours/Week                |   |   | C  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----|
|                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                   |                        | L                         | T | P |    |
| 240E617                                                                                                                                                                                                                                                                                                                                                                       | Software Engineering                                                                              | OE                     | 3                         | 0 | 0 | 3  |
| Regulation                                                                                                                                                                                                                                                                                                                                                                    | Nature of Course                                                                                  | Semester               | Data Book/Codes/Standards |   |   |    |
| R24                                                                                                                                                                                                                                                                                                                                                                           | Theory                                                                                            | 4                      |                           |   |   |    |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                       |                                                                                                   | Co-requisite Course(s) |                           |   |   |    |
| -                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                   | -                      |                           |   |   |    |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                             |                                                                                                   |                        |                           |   |   |    |
| 1                                                                                                                                                                                                                                                                                                                                                                             | To understand Software Engineering Lifecycle Models                                               |                        |                           |   |   |    |
| 2                                                                                                                                                                                                                                                                                                                                                                             | To Perform software requirements analysis                                                         |                        |                           |   |   |    |
| 3                                                                                                                                                                                                                                                                                                                                                                             | To gain knowledge of the System Analysis and Design concepts using UML.                           |                        |                           |   |   |    |
| 4                                                                                                                                                                                                                                                                                                                                                                             | To understand software testing and maintenance approaches                                         |                        |                           |   |   |    |
| 5                                                                                                                                                                                                                                                                                                                                                                             | To work on project management scheduling using DevOps                                             |                        |                           |   |   |    |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                               |                                                                                                   |                        |                           |   |   |    |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                                                                 |                                                                                                   |                        |                           |   |   |    |
| C617.1                                                                                                                                                                                                                                                                                                                                                                        | Describe and explain various Software Development Life Cycle (SDLC) models and their differences. |                        |                           |   |   | U  |
| C617.2                                                                                                                                                                                                                                                                                                                                                                        | Explain project management approaches as well as cost and schedule estimation strategies.         |                        |                           |   |   | U  |
| C617.3                                                                                                                                                                                                                                                                                                                                                                        | Develop formal analysis models based on software specifications.                                  |                        |                           |   |   | AP |
| C617.4                                                                                                                                                                                                                                                                                                                                                                        | Apply UML diagrams for analysis and design.                                                       |                        |                           |   |   | AP |
| C617.5                                                                                                                                                                                                                                                                                                                                                                        | Design architectural style, design patterns, and test the system                                  |                        |                           |   |   | AP |
| Course Contents                                                                                                                                                                                                                                                                                                                                                               |                                                                                                   |                        |                           |   |   |    |
| Unit-1                                                                                                                                                                                                                                                                                                                                                                        | SOFTWARE PROCESS AND AGILE DEVELOPMENT                                                            |                        |                           |   |   | 9  |
| Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – Introduction to Agility-Agile process-Extreme programming-XP Process-Case Study.                                                                                                                                                                                         |                                                                                                   |                        |                           |   |   |    |
| Unit – 2                                                                                                                                                                                                                                                                                                                                                                      | REQUIREMENTS ANALYSIS AND SPECIFICATION                                                           |                        |                           |   |   | 9  |
| Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petri nets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram- CASE TOOLS. |                                                                                                   |                        |                           |   |   |    |
| Unit – 3                                                                                                                                                                                                                                                                                                                                                                      | SOFTWARE DESIGN                                                                                   |                        |                           |   |   | 9  |
| Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns-Model-view-controller-Publish-subscribe-Adapter-Command-Strategy-Observer-Proxy-Facade-Architectural styles- Layered - Client Server - Tiered - Pipe and filter-User interface design-Case Study.                                                        |                                                                                                   |                        |                           |   |   |    |
| Unit – 4                                                                                                                                                                                                                                                                                                                                                                      | SOFTWARE TESTING AND MAINTENANCE                                                                  |                        |                           |   |   | 9  |
| Testing – Unit testing – Black box testing- White box testing – Integration and System testing- Regression testing – Debugging – Program analysis – Symbolic execution – Model Checking- Case Study                                                                                                                                                                           |                                                                                                   |                        |                           |   |   |    |
| Unit –5                                                                                                                                                                                                                                                                                                                                                                       | PROJECT MANAGEMENT                                                                                |                        |                           |   |   | 9  |
| Software Project Management- Software Configuration Management - Project Scheduling- DevOps: Motivation- Cloud as a platform- Operations- Deployment Pipeline: Overall Architecture Building and Testing- Deployment-Tools- Case Study                                                                                                                                        |                                                                                                   |                        |                           |   |   |    |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                   |                        |                           |   |   | 45 |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                   |                        |                           |   |   |    |

|   |                                                                                                                                                  |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Bernd Bruegge and Allen H. Dutoit, "Object-Oriented Software Engineering: Using UML, Patterns and Java", Third Edition, Pearson Education, 2009. |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------|

|                        |                                                                                                                                             |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 2                      | Roger S.Pressman, Object-Oriented Software Engineering:An AgileUnifiedMethodology, First Edition, Mc Graw-Hill International Edition, 2014. |
| <b>ReferenceBooks:</b> |                                                                                                                                             |
| 1                      | CarloGhezzi,MehdiJazayeri,DinoMandrioli,Fundamentals ofSoftwareEngineering,2nd edition, PHI Learning Pvt. Ltd., 2010.                       |
| 2                      | Len Bass, Ingo Weber and Liming Zhu, "DevOps: A Software Architect's Perspective", PearsonEducation, 2016                                   |
| 3                      | StephenSchach,Object-OrientedandClassicalSoftwareEngineering,8thed,McGraw-Hill,2010.                                                        |
| <b>WebReferences:</b>  |                                                                                                                                             |
| 1                      | Onlinecourses.nptel.ac.in                                                                                                                   |

| AssessmentbasedonContinuousandEndSemesterExamination |                      |                  |                           |                   |                    |                                |
|------------------------------------------------------|----------------------|------------------|---------------------------|-------------------|--------------------|--------------------------------|
| Bloom'sLevel                                         | ContinuousAssessment |                  |                           | Assignmen<br>t    | Atten<br>danc<br>e | End<br>SemesterExaminati<br>on |
|                                                      | CIA1<br>(6Marks)     | CIA2<br>(6Marks) | Model<br>Exam<br>(8Marks) |                   |                    |                                |
| Remember                                             |                      |                  |                           | (10<br>Marks<br>) | (10<br>Mark<br>s)  | (60Marks)                      |
| Understand                                           | 100%                 | 20%              | 40%                       |                   |                    |                                |
| Apply                                                |                      | 80%              | 60%                       |                   |                    |                                |
| Analyze                                              |                      |                  |                           |                   |                    |                                |
| Evaluate                                             |                      |                  |                           |                   |                    |                                |
| Create                                               |                      |                  |                           |                   |                    |                                |
| <b>Total(100<br/>Marks)</b>                          | <b>6</b>             | <b>6</b>         | <b>8</b>                  | <b>10</b>         | <b>10</b>          | <b>60</b>                      |

- CIA1,CIA 2andModelExamwillbeconductedfor 50,50and 100marks. Itshallbesubsequentlyconverted to 6, 6 and 8 marksrespectively.
- TheAssignment marks will be computed based onAssignment I,Assignment II andAssignment III marks convertedto 10 Marks.
- BTL mark split up may vary based on the nature ofthe subject

| COs/<br>POs | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO11 | PO12 | PS01 | PS02 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|------|------|------|------|
| C617.1      | 3       | 3       | 3       | 3       | 2       | -       | -       | -       | 2       | 2        | 2    | 2    | 2    | 2    |
| C617.2      | 3       | 3       | 3       | 3       | 3       | -       | -       | -       | 2       | 2        | 2    | 2    | 2    | 2    |
| C617.3      | 3       | 3       | 3       | 3       | 3       | -       | -       | -       | 2       | 2        | 2    | 2    | 2    | 2    |
| C617.4      | 3       | 3       | 3       | 3       | 3       | -       | -       | -       | 2       | 2        | 2    | 2    | 2    | 2    |
| C617.5      | 3       | 3       | 3       | 3       | 3       | -       | -       | -       | 2       | 2        | 2    | 2    | 2    | 2    |

3 - Strong2 - Moderate

1 - Weak

- - nocorrelation

| Course Code                                                                                                                                                                                                                                                                                                                    | Course Name                                                                                                                                                         | Category               | Hours/Week                |   |             | C  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-------------|----|
|                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                     |                        | L                         | T | P           |    |
| 240E618                                                                                                                                                                                                                                                                                                                        | Foundation of cloud computing                                                                                                                                       | OE                     | 3                         | 0 | 0           | 3  |
| Regulation R24                                                                                                                                                                                                                                                                                                                 | Nature of the Course                                                                                                                                                | Semester               | Data Book/Codes/Standards |   |             |    |
|                                                                                                                                                                                                                                                                                                                                | THEORY                                                                                                                                                              | 4                      | -----                     |   |             |    |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                     | Co-requisite Course(s) |                           |   |             |    |
| -                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                     | -                      |                           |   |             |    |
| Course Objectives                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                     |                        |                           |   |             |    |
| 1                                                                                                                                                                                                                                                                                                                              | To understand the principles of cloud architecture, models and infrastructure                                                                                       |                        |                           |   |             |    |
| 2                                                                                                                                                                                                                                                                                                                              | To understand the concepts of virtualization and virtual machines.                                                                                                  |                        |                           |   |             |    |
| 3                                                                                                                                                                                                                                                                                                                              | To gain knowledge about virtualization infrastructure.                                                                                                              |                        |                           |   |             |    |
| 4                                                                                                                                                                                                                                                                                                                              | To explore and experiment with various Cloud deployment environments.                                                                                               |                        |                           |   |             |    |
| 5                                                                                                                                                                                                                                                                                                                              | To learn about the security issues in the cloud environment.                                                                                                        |                        |                           |   |             |    |
| Course Outcomes                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                     |                        |                           |   |             |    |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                  |                                                                                                                                                                     |                        |                           |   |             |    |
| C618.1                                                                                                                                                                                                                                                                                                                         | Understand the design challenges in the cloud                                                                                                                       |                        |                           |   |             | U  |
| C618.2                                                                                                                                                                                                                                                                                                                         | Apply the concept of virtualization and its types                                                                                                                   |                        |                           |   |             | AP |
| C618.3                                                                                                                                                                                                                                                                                                                         | Demonstrate virtualization of hardware resources and Docker.                                                                                                        |                        |                           |   |             | AP |
| C618.4                                                                                                                                                                                                                                                                                                                         | Develop and deploy services on the cloud and set up a cloud environment.                                                                                            |                        |                           |   |             | AP |
| C618.5                                                                                                                                                                                                                                                                                                                         | Analyze the security challenges in the cloud environment.                                                                                                           |                        |                           |   |             | AP |
| Course Contents                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                     |                        |                           |   |             |    |
| Unit-1                                                                                                                                                                                                                                                                                                                         | CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE                                                                                                                        |                        |                           |   |             | 9  |
| Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges                                                             |                                                                                                                                                                     |                        |                           |   |             |    |
| Unit-2                                                                                                                                                                                                                                                                                                                         | VIRTUALIZATION BASICS                                                                                                                                               |                        |                           |   |             | 9  |
| Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.                            |                                                                                                                                                                     |                        |                           |   |             |    |
| Unit-3                                                                                                                                                                                                                                                                                                                         | VIRTUALIZATION INFRASTRUCTURE AND DOCKER                                                                                                                            |                        |                           |   |             | 9  |
| Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories |                                                                                                                                                                     |                        |                           |   |             |    |
| Unit-4                                                                                                                                                                                                                                                                                                                         | CLOUD DEPLOYMENT ENVIRONMENT                                                                                                                                        |                        |                           |   |             | 9  |
| Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack                                                                                                                                                                                                                         |                                                                                                                                                                     |                        |                           |   |             |    |
| Unit-5                                                                                                                                                                                                                                                                                                                         | CLOUD SECURITY                                                                                                                                                      |                        |                           |   |             | 9  |
| Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage; Identity and Access Management (IAM) – IAM Challenges – IAM Architecture and Practice.                                                                                                                  |                                                                                                                                                                     |                        |                           |   |             |    |
|                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                     |                        |                           |   | Total Hours | 45 |
| Textbooks:                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                     |                        |                           |   |             |    |
| 1                                                                                                                                                                                                                                                                                                                              | Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012 |                        |                           |   |             |    |
| 2                                                                                                                                                                                                                                                                                                                              | James Turnbull, "The Docker Book", O'Reilly Publishers, 2014.                                                                                                       |                        |                           |   |             |    |
| 3                                                                                                                                                                                                                                                                                                                              | Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud                                                                                   |                        |                           |   |             |    |

|                        |                                                                                                                                                                                                                                                                                                             |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | Computing”, Wiley Publishing, 2010.(checkedition)                                                                                                                                                                                                                                                           |
| <b>ReferenceBooks:</b> |                                                                                                                                                                                                                                                                                                             |
| 1                      | JamesE. Smith, RaviNair, “VirtualMachines: VersatilePlatformsforSystemsandProcesses”, Elsevier/MorganKaufmann, 2005.                                                                                                                                                                                        |
| 2                      | TimMather, SubraKumaraswamy, andShahedLatif, “CloudSecurityandPrivacy: anenterpriseerspectiveonrisksandcompliance”, O’ReillyMedia, Inc., 2009.                                                                                                                                                              |
| <b>WebReferences:</b>  |                                                                                                                                                                                                                                                                                                             |
| 1                      | <a href="https://medium.com/beyond-the-build/foundations-of-cloud-computing-saas-paas-iaas-for-product-managers-and-non-tech-professionals-63acf8c1a2bc">https://medium.com/beyond-the-build/foundations-of-cloud-computing-saas-paas-iaas-for-product-managers-and-non-tech-professionals-63acf8c1a2bc</a> |
| 2                      | <a href="https://onlinelibrary.wiley.com/">https://onlinelibrary.wiley.com/</a>                                                                                                                                                                                                                             |

| AssessmentbasedonContinuousandEndSemesterExamination |                      |                  |                       |                |                |                                |
|------------------------------------------------------|----------------------|------------------|-----------------------|----------------|----------------|--------------------------------|
| Bloom’sLevel                                         | ContinuousAssessment |                  |                       | Assign<br>ment | Attend<br>ance | End<br>SemesterExa<br>mination |
|                                                      | CIA1<br>(6Marks)     | CIA2<br>(6Marks) | ModelExam<br>(8Marks) |                |                |                                |
| Remember                                             |                      |                  |                       | (10<br>Marks)  | (10<br>Marks)  | (60Marks)                      |
| Understand                                           | 80%                  | 20%              | 20%                   |                |                |                                |
| Apply                                                | 20%                  | 80%              | 80%                   |                |                |                                |
| Analyze                                              |                      |                  |                       |                |                |                                |
| Evaluate                                             |                      |                  |                       |                |                |                                |
| Create                                               |                      |                  |                       |                |                |                                |
| <b>Total(100Marks)</b>                               | <b>6</b>             | <b>6</b>         | <b>8</b>              | <b>10</b>      | <b>10</b>      | <b>60</b>                      |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject

| COs/<br>POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PS02 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| C618.1      | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | 3    | 3    | 3    | 3    | 3    |
| C618.2      | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | 3    | 3    | 3    | 3    | 3    |
| C618.3      | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | 3    | 3    | 3    | 3    | 3    |
| C618.4      | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | 3    | 3    | 3    | 3    | 3    |
| C618.5      | 3   | 3   | 3   | 3   | 3   | -   | -   | -   | 3   | 3    | 3    | 3    | 3    | 3    |

3 - Strong

2 - Moderate

1 - Weak

- - no correlation

| Course Code                                                                                                                                                                                                                                                                                                                                 | Course Name                                                                    | Category               | Hours/Week                |   |             | C  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------|---------------------------|---|-------------|----|
|                                                                                                                                                                                                                                                                                                                                             |                                                                                |                        | L                         | T | P           |    |
| 24OE619                                                                                                                                                                                                                                                                                                                                     | JAVA PROGRAMMING                                                               | OE                     | 3                         | 0 | 0           | 3  |
| Regulation                                                                                                                                                                                                                                                                                                                                  | Nature of the Course                                                           | Semester               | Data Book/Codes/Standards |   |             |    |
| R24                                                                                                                                                                                                                                                                                                                                         | THEORY                                                                         | -                      | -----                     |   |             |    |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                     |                                                                                | Co-requisite Course(s) |                           |   |             |    |
| -                                                                                                                                                                                                                                                                                                                                           |                                                                                | -                      |                           |   |             |    |
| Course Objectives                                                                                                                                                                                                                                                                                                                           |                                                                                |                        |                           |   |             |    |
| 1.                                                                                                                                                                                                                                                                                                                                          | Learn fundamental features of object oriented language and JAVA.               |                        |                           |   |             |    |
| 2.                                                                                                                                                                                                                                                                                                                                          | Set up a Java JDK environment to create, debug and run simple Java programs.   |                        |                           |   |             |    |
| 3.                                                                                                                                                                                                                                                                                                                                          | Learn object oriented concepts using programming examples.                     |                        |                           |   |             |    |
| 4.                                                                                                                                                                                                                                                                                                                                          | Study the concepts of importing packages and exception handling mechanisms.    |                        |                           |   |             |    |
| 5.                                                                                                                                                                                                                                                                                                                                          | Discuss the String Handling examples with Object Oriented concepts.            |                        |                           |   |             |    |
| Course Outcomes                                                                                                                                                                                                                                                                                                                             |                                                                                |                        |                           |   |             |    |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                               |                                                                                |                        |                           |   |             |    |
| C619.1                                                                                                                                                                                                                                                                                                                                      | Write simple programs in JAVA                                                  |                        |                           |   |             | AP |
| C619.2                                                                                                                                                                                                                                                                                                                                      | Implement JAVA program using operators and statements                          |                        |                           |   |             | AP |
| C619.3                                                                                                                                                                                                                                                                                                                                      | Demonstrate JAVA with classes and objects                                      |                        |                           |   |             | AP |
| C619.4                                                                                                                                                                                                                                                                                                                                      | Implement JAVA in creating packages and Exception handling                     |                        |                           |   |             | AP |
| C619.5                                                                                                                                                                                                                                                                                                                                      | Demonstrate JAVA program in String Handling and File Handling                  |                        |                           |   |             | AP |
| Course Contents                                                                                                                                                                                                                                                                                                                             |                                                                                |                        |                           |   |             |    |
| Unit-I                                                                                                                                                                                                                                                                                                                                      | INTRODUCTION                                                                   |                        |                           |   |             | 9  |
| An Overview of Java: Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries, Data Types, Variables, and Arrays: The Primitive Data Types, Variables, Type Conversion and Casting, Arrays.                                      |                                                                                |                        |                           |   |             |    |
| Unit-II                                                                                                                                                                                                                                                                                                                                     | JAVA OPERATORS AND STATEMENTS                                                  |                        |                           |   |             | 9  |
| Operators: Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The Ternary Operator, Operator Precedence, Using Parentheses, Control Statements: Java's Selection Statements, Iteration Statements, Jump Statements.                                                     |                                                                                |                        |                           |   |             |    |
| Unit-III                                                                                                                                                                                                                                                                                                                                    | CLASSES AND OBJECTS                                                            |                        |                           |   |             | 9  |
| Introducing Classes: Class Fundamentals, Constructors, the "this" Keyword, Methods and Classes: Overloading Methods, Recursion, Access Control, Inheritance: Inheritance, Using super, Multilevel Hierarchy, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, The Object Class.            |                                                                                |                        |                           |   |             |    |
| Unit-IV                                                                                                                                                                                                                                                                                                                                     | PACKAGES AND EXCEPTION HANDLING                                                |                        |                           |   |             | 9  |
| Packages and Interfaces: Packages, Access Protection, Importing Packages, Interfaces, Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, User Defined Exception Subclasses. |                                                                                |                        |                           |   |             |    |
| Unit-V                                                                                                                                                                                                                                                                                                                                      | I/O STREAM AND STRING CLASS                                                    |                        |                           |   |             | 9  |
| I/O Basics, Reading Console Input, Writing Console Output, The PrintWriter Class, Reading and Writing Files. String Handling: The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Additional String Methods, StringBuffer, StringBuilder.    |                                                                                |                        |                           |   |             |    |
|                                                                                                                                                                                                                                                                                                                                             |                                                                                |                        |                           |   | Total Hours | 45 |
| Textbooks:                                                                                                                                                                                                                                                                                                                                  |                                                                                |                        |                           |   |             |    |
| 1.                                                                                                                                                                                                                                                                                                                                          | Herbert Schildt, Java The Complete Reference, 13th Edition, McGraw Hill, 2024. |                        |                           |   |             |    |

**ReferenceBooks:**

|                       |                                                                                                                         |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------|
| 1.                    | EBalagurusamy, Programming with Java A primer, Tata McGraw Hill companies, 7th Edition, 2023.                           |
| 2.                    | Kathy Sierra, Bert Bates, Trisha Gee, Head First Java: A Brain-Friendly Guide, Third Edition, 2022.                     |
| <b>WebReferences:</b> |                                                                                                                         |
| 1.                    | <a href="https://onlinecourses.nptel.ac.in/noc25_cs57/preview">https://onlinecourses.nptel.ac.in/noc25_cs57/preview</a> |

**Assessment based on Continuous and End Semester Examination**

| Bloom's Level          | Continuous Assessment |               |                     | Assignment | Attendance | End Semester Examination |
|------------------------|-----------------------|---------------|---------------------|------------|------------|--------------------------|
|                        | CIA1 (6Marks)         | CIA2 (6Marks) | Model Exam (8Marks) |            |            |                          |
| Remember               |                       |               |                     | (10Marks)  | (10Marks)  | (60Marks)                |
| Understand             | 20%                   | 20%           | 20%                 |            |            |                          |
| Apply                  | 80%                   | 80%           | 80%                 |            |            |                          |
| Analyze                |                       |               |                     |            |            |                          |
| Evaluate               |                       |               |                     |            |            |                          |
| Create                 |                       |               |                     |            |            |                          |
| <b>Total(100Marks)</b> | <b>6</b>              | <b>6</b>      | <b>8</b>            | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS 01 | PS 02 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C619.1      | 3    | 3    | -    | -    | -    | -    | -    | -    | -    | -     | -     | 2     | -     | -     |
| C619.2      | 3    | 3    | -    | -    | -    | -    | -    | -    | -    | -     | -     | 2     | -     | -     |
| C619.3      | 3    | 3    | 3    | 2    | -    | -    | -    | -    | -    | -     | -     | 3     | -     | -     |
| C619.4      | 3    | 3    | 3    | 2    | -    | -    | -    | -    | -    | -     | -     | 3     | -     | -     |
| C619.5      | 3    | 3    | 3    | 2    | -    | -    | -    | -    | -    | -     | -     | 3     | -     | -     |

3 - Strong 2 - Moderate

1- Weak

'-'- no correlation

| Course Code                                                                                                                                                                                                                                           | Course Name                                                                                                                                                                           | Category               | Hours/Week                |   |   | C  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|----|
|                                                                                                                                                                                                                                                       |                                                                                                                                                                                       |                        | L                         | T | P |    |
| 24OE620                                                                                                                                                                                                                                               | BLOCKCHAIN TECHNOLOGY                                                                                                                                                                 | OE                     | 3                         | 0 | 0 | 3  |
| Regulation                                                                                                                                                                                                                                            | Nature of the Course                                                                                                                                                                  | Semester               | Data Book/Codes/Standards |   |   |    |
| R24                                                                                                                                                                                                                                                   | Theory                                                                                                                                                                                | 4                      | -----                     |   |   |    |
| Pre-requisite Course(s)                                                                                                                                                                                                                               |                                                                                                                                                                                       | Co-requisite Course(s) |                           |   |   |    |
| Data Structures and Algorithms, Programming in C and Java                                                                                                                                                                                             |                                                                                                                                                                                       | Operating Systems      |                           |   |   |    |
| Course Objectives                                                                                                                                                                                                                                     |                                                                                                                                                                                       |                        |                           |   |   |    |
| 1                                                                                                                                                                                                                                                     | To understand the basics of Blockchain                                                                                                                                                |                        |                           |   |   |    |
| 2                                                                                                                                                                                                                                                     | To learn different protocols and consensus algorithms in Blockchain                                                                                                                   |                        |                           |   |   |    |
| 3                                                                                                                                                                                                                                                     | To learn the Blockchain implementation frameworks                                                                                                                                     |                        |                           |   |   |    |
| 4                                                                                                                                                                                                                                                     | To understand Smart contracts and Ethereum 101                                                                                                                                        |                        |                           |   |   |    |
| 5                                                                                                                                                                                                                                                     | To understand blockchain alternatives and its applications                                                                                                                            |                        |                           |   |   |    |
| Course Outcomes                                                                                                                                                                                                                                       |                                                                                                                                                                                       |                        |                           |   |   |    |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                         |                                                                                                                                                                                       |                        |                           |   |   |    |
| C620.1                                                                                                                                                                                                                                                | Understand emerging abstract models of blockchain technology                                                                                                                          |                        |                           |   |   | U  |
| C620.2                                                                                                                                                                                                                                                | Explain major research challenges and technical gaps existing between theory and practice in the crypto currency domain                                                               |                        |                           |   |   | U  |
| C620.3                                                                                                                                                                                                                                                | Illustrate the Bitcoin features and its alternative options.                                                                                                                          |                        |                           |   |   | U  |
| C620.4                                                                                                                                                                                                                                                | Describe and deploy the smart contracts and Ethereum platform                                                                                                                         |                        |                           |   |   | U  |
| C620.5                                                                                                                                                                                                                                                | Apply the blockchain features outside of currencies.                                                                                                                                  |                        |                           |   |   | AP |
| Course Contents                                                                                                                                                                                                                                       |                                                                                                                                                                                       |                        |                           |   |   |    |
| Unit -1                                                                                                                                                                                                                                               | INTRODUCTION TO BLOCKCHAIN                                                                                                                                                            |                        |                           |   |   | 9  |
| Blockchain-Public Ledgers, Blockchain as Public Ledgers-Block in a Blockchain, Transactions-The Chain and the Longest Chain-Permissioned Model of Blockchain, Cryptographic-Hash Function, Properties of a hash function-Hash pointer and Merkle tree |                                                                                                                                                                                       |                        |                           |   |   |    |
| Unit -2                                                                                                                                                                                                                                               | BITCOIN AND CRYPTOCURRENCY                                                                                                                                                            |                        |                           |   |   | 9  |
| A basic cryptocurrency, Creation of coins, Payments and double spending, FORTH-the precursor for Bitcoin scripting, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay             |                                                                                                                                                                                       |                        |                           |   |   |    |
| Unit -3                                                                                                                                                                                                                                               | BITCOIN CONSENSUS                                                                                                                                                                     |                        |                           |   |   | 9  |
| Bitcoin Consensus, Proof of Work (PoW)-Hashcash PoW, Bitcoin PoW, Attack on PoW, monopoly problem-Proof of Stake-Proof of Burn-Proof of Elapsed Time-Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.                  |                                                                                                                                                                                       |                        |                           |   |   |    |
| Unit -4                                                                                                                                                                                                                                               | SMART CONTRACTS AND ETHEREUM 101                                                                                                                                                      |                        |                           |   |   | 9  |
| Smart Contracts: Definition, Ricardian contracts. Ethereum 101: Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts.                                                                                        |                                                                                                                                                                                       |                        |                           |   |   |    |
| Unit -5                                                                                                                                                                                                                                               | BLOCKCHAIN ALTERNATIVES & ITS APPLICATIONS                                                                                                                                            |                        |                           |   |   | 9  |
| Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Banking, Insurance, etc-Case Study.                                            |                                                                                                                                                                                       |                        |                           |   |   |    |
| Total Hours                                                                                                                                                                                                                                           |                                                                                                                                                                                       |                        |                           |   |   | 45 |
| Textbooks:                                                                                                                                                                                                                                            |                                                                                                                                                                                       |                        |                           |   |   |    |
| 1                                                                                                                                                                                                                                                     | Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly, 2014.                                                                                        |                        |                           |   |   |    |
| 2                                                                                                                                                                                                                                                     | Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017                                         |                        |                           |   |   |    |
| 3                                                                                                                                                                                                                                                     | Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Author- Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1- 78712-544-5, 2017 |                        |                           |   |   |    |
| Reference Books:                                                                                                                                                                                                                                      |                                                                                                                                                                                       |                        |                           |   |   |    |
| 1                                                                                                                                                                                                                                                     | Bitcoin and Cryptocurrency Technologies, Author- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University, 2016                         |                        |                           |   |   |    |

|                       |                                                                                                                 |
|-----------------------|-----------------------------------------------------------------------------------------------------------------|
| 2                     | DanielDrescher, "BlockchainBasics", FirstEdition, Apress, 2017.                                                 |
| 3                     | BlockchainBasics: A Non-Technical Introduction in 25 Steps, Author-DanielDrescher, Apress, First Edition, 2017  |
| 4                     | MasteringBitcoin:UnlockingDigitalCryptocurrencies,AndreasM.Antonopoulos,O'ReillyMedia, FirstEdition, 2014       |
| 5                     | HandbookofResearchonBlockchainTechnology, publishedbyElsevierInc. ISBN:9780128198162, 2020.                     |
| <b>WebReferences:</b> |                                                                                                                 |
| 1                     | <a href="https://blockchain-society.science/">https://blockchain-society.science/</a>                           |
| 2                     | <a href="https://www.coursera.org/learn/blockchain-basics">https://www.coursera.org/learn/blockchain-basics</a> |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                                                    |                       |                   |                         | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand                                                  | 100%                  | 80%               | 80%                     |            |            |                          |
| Apply                                                       |                       | 20%               | 20%                     |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total(100 Marks)</b>                                     | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| C620.1      | 3    | -    | -    | -    | -    | -    | -    | -    | -    | -     | -     | -     | 3     | 3     |
| C620.2      | 3    | 2    | 2    | 2    | 3    | 2    | 2    | 2    | -    | -     | -     | -     | 3     | 3     |
| C620.3      | 3    | 2    | 2    | 2    | 3    | 2    | 2    | 2    | -    | -     | -     | -     | 3     | 3     |
| C620.4      | 3    | 2    | 2    | 2    | 3    | 2    | 2    | 2    | -    | -     | -     | -     | 3     | 3     |
| C620.5      | 3    | 2    | 2    | 2    | 3    | 2    | 2    | 2    | -    | -     | -     | -     | 3     | 3     |

3 - Strong

2 - Moderate

1 - Weak

- - no correlation

| CourseCode                                                                                                                                                                                                                                                                                         | CourseName                                                                                                                                 | Category              | Hours/Week               |   |            | C  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|------------|----|
|                                                                                                                                                                                                                                                                                                    |                                                                                                                                            |                       | L                        | T | P          |    |
| 240E621                                                                                                                                                                                                                                                                                            | IntroductiontoVLSI design                                                                                                                  | OE                    | 3                        | 0 | 0          | 3  |
| Regulation                                                                                                                                                                                                                                                                                         | NatureoftheCourse                                                                                                                          | Semester              | DataBook/Codes/Standards |   |            |    |
| R24                                                                                                                                                                                                                                                                                                | Theory                                                                                                                                     | -                     | -----                    |   |            |    |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                             |                                                                                                                                            | Co-requisiteCourse(s) |                          |   |            |    |
| -                                                                                                                                                                                                                                                                                                  |                                                                                                                                            | -                     |                          |   |            |    |
| CourseObjectives                                                                                                                                                                                                                                                                                   |                                                                                                                                            |                       |                          |   |            |    |
| 1                                                                                                                                                                                                                                                                                                  | To learn the fundamentals ofVLSI design                                                                                                    |                       |                          |   |            |    |
| 2                                                                                                                                                                                                                                                                                                  | To understand the IC Manufacturing Process                                                                                                 |                       |                          |   |            |    |
| 3                                                                                                                                                                                                                                                                                                  | To familiarize with VLSI combinational logic circuitsdesign                                                                                |                       |                          |   |            |    |
| 4                                                                                                                                                                                                                                                                                                  | To familiarize with VLSI sequential logiccircuits design                                                                                   |                       |                          |   |            |    |
| 5                                                                                                                                                                                                                                                                                                  | To familiarize with the different FPGA architectures                                                                                       |                       |                          |   |            |    |
| CourseOutcomes                                                                                                                                                                                                                                                                                     |                                                                                                                                            |                       |                          |   |            |    |
| Uponcompletionofthecourse,studentsshallhaveabilityto                                                                                                                                                                                                                                               |                                                                                                                                            |                       |                          |   |            |    |
| C621.1                                                                                                                                                                                                                                                                                             | Ability to comprehend and appreciate the significance and role ofthiscoursein the present contemporary world                               |                       |                          |   |            | U  |
| C621.2                                                                                                                                                                                                                                                                                             | At the end ofthe coursestudents will be in a position to understand the basicsofVLSI design                                                |                       |                          |   |            | U  |
| C621.3                                                                                                                                                                                                                                                                                             | At the end ofthe coursestudents will be in a position to understand the basicsof testing                                                   |                       |                          |   |            | U  |
| C621.4                                                                                                                                                                                                                                                                                             | At the end ofthe coursestudents will be in a position to understand the basicsofdifferentFPGA architectures.                               |                       |                          |   |            | U  |
| CourseContents                                                                                                                                                                                                                                                                                     |                                                                                                                                            |                       |                          |   |            |    |
| Unit -1                                                                                                                                                                                                                                                                                            | MOSTRANSISTORPRINCIPLES                                                                                                                    |                       |                          |   |            | 9  |
| MOSTechnologyandVLSI, Passtransistors, NMOS, CMOS FabricationprocessandElectricalpropertiesofCMOS circuits. Characteristics of CMOS inverter, Scaling principles and fundamental limits. PropagationDelays, CMOS inverter scaling, Stick diagram, Layoutdiagrams, Elmore'sconstant, LogicalEffort. |                                                                                                                                            |                       |                          |   |            |    |
| Unit - 2                                                                                                                                                                                                                                                                                           | COMBINATIONALLOGICCIRCUITS                                                                                                                 |                       |                          |   |            | 9  |
| StaticCMOSLogicDesign, Designtechniques toimprovethe speed, powerdissipationof CMOSlogic, lowpowercircuittechniques, Ratioedlogic. Pass transistorLogic, DynamicCMOSLogic, Dominologic, DualRaillogic, NP CMOS logic and NOR arraylogic.                                                           |                                                                                                                                            |                       |                          |   |            |    |
| Unit -3                                                                                                                                                                                                                                                                                            | SEQUENTIALLOGICCIRCUITS                                                                                                                    |                       |                          |   |            | 9  |
| Static and Dynamic Latchesand Registers, TimingIssues, Pipelines, Clockingstrategies, MemoryArchitectures, and Memory control circuits.                                                                                                                                                            |                                                                                                                                            |                       |                          |   |            |    |
| Unit - 4                                                                                                                                                                                                                                                                                           | DESIGNINGARITHMETICBUILDINGBLOCKS&TESTING                                                                                                  |                       |                          |   |            | 9  |
| Datapath circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters, Need for testing-Manufacturing test principles- Design for testability.                                                                                                                                   |                                                                                                                                            |                       |                          |   |            |    |
| Unit -5                                                                                                                                                                                                                                                                                            | IMPLEMENTATIONSTRATEGIES                                                                                                                   |                       |                          |   |            | 9  |
| FullCustomandSemicustomDesign, StandardCell designandcelllibraries, FPGAbuildingblockarchitecture s, FPGAinterconnectroutingprocedures. Demo: CompleteASICflowusing Backendtoolandfabrication flow Overall case study: Development ofIC incommercialaspects(design, testingandfabcost)             |                                                                                                                                            |                       |                          |   |            |    |
|                                                                                                                                                                                                                                                                                                    |                                                                                                                                            |                       |                          |   | TotalHours | 45 |
| Textbooks:                                                                                                                                                                                                                                                                                         |                                                                                                                                            |                       |                          |   |            |    |
| 1                                                                                                                                                                                                                                                                                                  | Jan Rabaey, AnanthaChandrakasan, B.Nikolic, "Digital Integrated circuits: A design perspective". SecondEdition, PrenticeHallofIndia, 2003. |                       |                          |   |            |    |
| ReferenceBooks:                                                                                                                                                                                                                                                                                    |                                                                                                                                            |                       |                          |   |            |    |
| 1                                                                                                                                                                                                                                                                                                  | N.Weste, K.Eshraghian, "Principles ofCMOS VLSI DESIGN", A system Perspective,secondedition, AddisonWesley 2004                             |                       |                          |   |            |    |
| 2                                                                                                                                                                                                                                                                                                  | A.Pucknell, KamranEshraghian, "BASICVLSIDESIGN", Thirddedition, PrenticeHallofIndia,2007.                                                  |                       |                          |   |            |    |
| 3                                                                                                                                                                                                                                                                                                  | M.J.Smith, "Applicationspecificintegratedcircuits", AddisonWesley,1997                                                                     |                       |                          |   |            |    |
| 4                                                                                                                                                                                                                                                                                                  | R.JacobBaker, HarryW.LI., DavidE.Boyee, "CMOSCircuitDesign, LavoutandSimulation", 2005 PrenticeHallofIndia                                 |                       |                          |   |            |    |



| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                                                    | 12%                   | 12%               | 6%                      | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand                                                  | 58%                   | 58%               | 58%                     |            |            |                          |
| Apply                                                       | 30%                   | 30%               | 36%                     |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| C621.1      | 3   | 3   | 3   | 3   |     | 3   |     |     |     | 3    | 3    |      |      |      |
| C621.2      | 3   | 3   | 3   | 3   |     | 3   |     |     |     | 3    | 3    |      |      |      |
| C621.3      | 3   | 3   | 3   | 3   |     | 3   |     |     |     | 3    | 3    |      |      |      |
| C621.4      | 3   | 3   | 3   | 3   |     | 3   |     |     |     | 3    | 3    |      |      |      |

| CourseCode                                                                                                                                                                                                                                                                                                                | CourseName                                                                                                                                                              | Category              | Hours/Week               |   |            | C   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|------------|-----|
|                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                         |                       | L                        | T | P          |     |
| 240E622                                                                                                                                                                                                                                                                                                                   | CommunicationEngineering                                                                                                                                                | OE                    | 3                        | 0 | 0          | 3   |
| Regulation                                                                                                                                                                                                                                                                                                                | NatureoftheCourse                                                                                                                                                       | Semester              | DataBook/Codes/Standards |   |            |     |
| R24                                                                                                                                                                                                                                                                                                                       | Theory                                                                                                                                                                  | -                     | -----                    |   |            |     |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                         | Co-requisiteCourse(s) |                          |   |            |     |
| Linear Integrated Circuits                                                                                                                                                                                                                                                                                                |                                                                                                                                                                         | -                     |                          |   |            |     |
| CourseOutcomes:<br>Uponcompletionofthecourse,studentsshallhaveabilityto                                                                                                                                                                                                                                                   |                                                                                                                                                                         |                       |                          |   |            |     |
| C622.1                                                                                                                                                                                                                                                                                                                    | Gain insight into communication systems with signal processing,modulation,channelcharacteristics, and multiple access techniques                                        |                       |                          |   |            | [U] |
| C622.2                                                                                                                                                                                                                                                                                                                    | Infer the principles ofAM generation, demodulation, system comparisons, transmitterandreceiver design ofFMsystems                                                       |                       |                          |   |            | [U] |
| C622.3                                                                                                                                                                                                                                                                                                                    | Understand the generation, detection, and performance analysis ofdigital modulationschemes, including ASK, FSK, BPSK, QPSK, andQAM                                      |                       |                          |   |            | [U] |
| C622.4                                                                                                                                                                                                                                                                                                                    | Interpret information theory fundamentals, channel capacity,Shannon's theorems, sourcecoding techniques, and error control coding forefficientand reliablecommunication |                       |                          |   |            | [U] |
| C622.5                                                                                                                                                                                                                                                                                                                    | Comprehend advanced wireless communication technologies and their associatedstandards                                                                                   |                       |                          |   |            | [U] |
| CourseContents                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                         |                       |                          |   |            |     |
| Unit -1                                                                                                                                                                                                                                                                                                                   | PRINCIPLESOFCOMMUNICATION                                                                                                                                               |                       |                          |   |            | 9   |
| CommunicationSystemsOverview-Typesof CommunicationChannels-BasicSignalProcessingOperationsinCommunicationsystems-BasebandandPassbandModeling-Signal-to-NoiseRatio,ChannelBandwidth,Modulation,Spectral density - Multiplexing, Multiple Access                                                                            |                                                                                                                                                                         |                       |                          |   |            |     |
| Unit - 2                                                                                                                                                                                                                                                                                                                  | ANALOGCOMMUNICATIONSYSTEMS                                                                                                                                              |                       |                          |   |            | 9   |
| Generation and demodulationofAM- DSB-SC,SSB-SC, VSB AmplitudeModulatedSignals- ComparisonofAMsystem-AMtransmitters, AM receivers-Anglemodulation:PhaseModulation, FrequencyModulation-Narrowband and wideband FM - Non-linear effects in FMsystems- FM receivers                                                          |                                                                                                                                                                         |                       |                          |   |            |     |
| Unit -3                                                                                                                                                                                                                                                                                                                   | DIGITALCOMMUNICATIONSYSTEMS                                                                                                                                             |                       |                          |   |            | 9   |
| Generation and detectionof Amplitude Shift Keying(ASK)Modulation - GenerationanddetectionofFrequencyShiftKeying(FSK)Modulation-Generationanddetectionof BinaryPhaseShiftKeying(BPSK)Modulation- Generation and detectionofQuaternaryPhaseShiftKeyingQPSK)-QAM-BitErrorRatePerformance ofBPSK, QPSK and QAM in AWGNchannel |                                                                                                                                                                         |                       |                          |   |            |     |
| Unit - 4                                                                                                                                                                                                                                                                                                                  | INFORMATIONTHEORY                                                                                                                                                       |                       |                          |   |            | 9   |
| Measureof information-ChannelcapacityandShannonstheorems-Sourcecodingtechniques:Prefixcode, HuffmanCoding, ShannonFanoCoding, ArithmeticCoding, Runlengthcode - Channelcodingtheorem,Information capacity theorem - Error Control Coding                                                                                  |                                                                                                                                                                         |                       |                          |   |            |     |
| Unit -5                                                                                                                                                                                                                                                                                                                   | ADVANCEDCOMMUNICATIONSYSTEMS                                                                                                                                            |                       |                          |   |            | 9   |
| SpreadSpectrum,OFDM,GSMarchitecture,GeneralPacketRadioService (GPRS), EnhancedData RateforGlobalEvolution(EDGE),Ultrawidebandsystems(UWB),Push-To-Talk(PTT)technology,Mobile IP, Bluetooth Technology, IEEEStandards for Wired and WirelessCommunications                                                                 |                                                                                                                                                                         |                       |                          |   |            |     |
|                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                         |                       |                          |   | TotalHours | 45  |
| Textbooks:                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                         |                       |                          |   |            |     |
| 1                                                                                                                                                                                                                                                                                                                         | SimonHaykin, CommunicationSystems, JohnWiley&sons, NY,5thEdition, 2016                                                                                                  |                       |                          |   |            |     |
| 2                                                                                                                                                                                                                                                                                                                         | Michael P. Fitz, Fundamentals ofCommunicationSystems, Tata McGraw-Hill, 2nd Edition- 2013.                                                                              |                       |                          |   |            |     |
| ReferenceBooks:                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                         |                       |                          |   |            |     |
| 1                                                                                                                                                                                                                                                                                                                         | Taub andSchilling, Principles ofcommunication systems, TMH, New Delhi, 4th Edition,2017                                                                                 |                       |                          |   |            |     |
| 2                                                                                                                                                                                                                                                                                                                         | TheodoreS. Rappaport: Wireless communication principles and practice,2/e. Pearson Education                                                                             |                       |                          |   |            |     |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                                                    | 20%                   | 20%               | 20%                     | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand                                                  | 80%                   | 80%               | 80%                     |            |            |                          |
| Apply                                                       |                       |                   |                         |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-------------|------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| C622.1      | 2    | 2   | 1   |     |     |     |     |     |     |      | 1    |
| C622.2      | 2    | 2   | 1   |     |     |     |     |     |     |      | 1    |
| C622.3      | 2    | 2   | 1   |     |     |     |     |     |     |      | 1    |
| C622.4      | 2    | 2   | 1   |     |     |     |     |     |     |      | 1    |
| C622.5      | 2    | 2   | 1   |     |     |     |     |     |     |      | 1    |

| Course Code                                                   | Course Name                                                                              | Category | Hours/Week |   |   | C   |
|---------------------------------------------------------------|------------------------------------------------------------------------------------------|----------|------------|---|---|-----|
|                                                               |                                                                                          |          | L          | T | P |     |
| 240E623                                                       | SENSORS AND ACTUATORS                                                                    | OE       | 3          | 0 | 0 | 3   |
| <b>Course Outcomes(s)</b>                                     |                                                                                          |          |            |   |   |     |
| Upon completion of the course, students shall have ability to |                                                                                          |          |            |   |   | RBT |
| C623.1                                                        | List common types of sensor and actuators used in vehicles                               |          |            |   |   | U   |
| C623.2                                                        | Design measuring equipment's for the measurement of pressure force, temperature and flow |          |            |   |   | AP  |
| C623.3                                                        | Generate new ideas in designing the sensors and actuators for automotive application     |          |            |   |   | AP  |
| C624.4                                                        | Understand the operation of the sensors, actuators and electronic control.               |          |            |   |   | U   |
| C624.5                                                        | Design temperature control actuators for vehicles.                                       |          |            |   |   | AP  |

| CourseContent                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                       |                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Unit-I                                                                                                                                                                                                                                                                                                                                                                                                                                                 | INTRODUCTION TO MEASUREMENTS ANDSENSORS                                                                                                               | 9                     |
| Sensors:Functions-Classifications-<br>MaintechnicalrequirementandtrendsUnitsandstandardsCalibrationmethods-Classificationoferrors-<br>Erroranalysis-Limitingerror-ProbableerrorPropagationoferror-Oddsanduncertainty-principle<br>oftransduction-Classification. Static characteristics-mathematicalmodelof transducers-<br>Zero,FirstandSecond order transducers Dynamic characteristics offirst andsecond order<br>transducersforstandardtestinputs. |                                                                                                                                                       |                       |
| Unit – II                                                                                                                                                                                                                                                                                                                                                                                                                                              | VARIABLE RESISTANCE AND INDUCTANCESENSORS                                                                                                             | 9                     |
| Principleof operation-Constructiondetails-Characteristicsandapplicationsof resistivepotentiometer-<br>Straingauges-Resistivethermometers-Thermistors-PiezoresistivesensorsInductivepotentiometer-<br>Variable reluctancetransducers:-EI pick up and LVDT                                                                                                                                                                                               |                                                                                                                                                       |                       |
| Unit – III                                                                                                                                                                                                                                                                                                                                                                                                                                             | VARIABLE AND OTHER SPECIALSENSORS                                                                                                                     | 9                     |
| Variableairgap type,variableareatypeandvariablepermittivitytype-<br>capacitormicrophonePiezoelectric,Magnetostrictive,HallEffect,semiconductorsensor-digital transducers-<br>Humidity Sensor.Rainsensor,climaticcondition sensor, solar, lightsensor,antiglaresensor.                                                                                                                                                                                  |                                                                                                                                                       |                       |
| Unit – IV                                                                                                                                                                                                                                                                                                                                                                                                                                              | AUTOMOTIVE ACTUATORS                                                                                                                                  | 9                     |
| Electromechanicalactuators_Fluid_mechanicalactuators_Electricalmachines_Direct_currentmachines_Three_ph<br>ase machines_Single_phasealternating_currentMachines_Duty_typeratings318 forelectricalmachines.Working<br>principles, construction and location ofactuators viz.Solenoid, relay, stepper motoretc.                                                                                                                                          |                                                                                                                                                       |                       |
| Unit – V                                                                                                                                                                                                                                                                                                                                                                                                                                               | AUTOMATIC TEMPERATURE CONTROL ACTUATORS                                                                                                               | 9                     |
| Different types ofactuators used in automatic temperaturecontrol_Fixedand<br>variabledisplacementtemperaturecontrol_Semi Automatic_Controller design for Fixed and<br>variabledisplacementtypeairconditioningsystem.                                                                                                                                                                                                                                   |                                                                                                                                                       |                       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                       | TOTAL:<br>45Ho<br>urs |
| LearningResources                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                       |                       |
| Text Books                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                       |                       |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Doebelin's Measurement Systems: 7th Edition (SIE),ErnestO.<br>DoebelinDhaneshN.Manik,McGraw Hill Publishers, 2019.                                    |                       |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                      | RobertBrandy, “ AutomotiveElectronicsandComputerSystem”, PrenticeHall,2001                                                                            |                       |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                      | WilliamKimberley,” BoschAutomotiveHandbook”, 6thEdition, RobertBoschGmbH, 2004.                                                                       |                       |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Bosch Automotive Electrics and Automotive ElectronicsSystems andComponents,<br>NetworkingandHybrid Drive, 5thEdition, 2007, ISBNNo:978_3_658_01783_5. |                       |
| Reference Books                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                       |                       |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                      | JamesDHalderman, “ AutomotiveElectricalandElectronics” ,PrenticeHall, USA,2013                                                                        |                       |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Tom Denton, “Automotive Electrical and ElectronicsSystems,” Third Edition, 2004,SAEInternational.                                                     |                       |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Patranabis.D. “ SensorsandTransducers”. 2ndEdition. PrenticeHallIndiaLtd,2003                                                                         |                       |

|   |                                                                                                                                              |
|---|----------------------------------------------------------------------------------------------------------------------------------------------|
| 4 | William Ribbens, "UnderstandingAutomotiveElectronics _An Engineering Perspective,"7thEdition, ElsevierButterworth_HeinemannPublishers, 2012. |
|---|----------------------------------------------------------------------------------------------------------------------------------------------|

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                                                    |                       |                   | 10%                     | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand                                                  | 60%                   | 40%               | 40%                     |            |            |                          |
| Apply                                                       | 40%                   | 60%               | 50%                     |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|-------------|------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| C622.1.     | 2    | 2   | 1   |     |     |     |     |     |     |      | 1    |
| C622.2      | 3    | 3   | 2   |     |     |     |     |     |     |      | 1    |
| C622.3      | 3    | 3   | 2   |     |     |     |     |     |     |      | 1    |
| C666.4      | 2    | 2   | 1   |     |     |     |     |     |     |      | 1    |
| C666.5      | 3    | 3   | 2   |     |     |     |     |     |     |      | 1    |

| CourseCode                                                                                                                                                                                                                                      | CourseName                                                                                                              | Category              | Hours/Week |   |            | C    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-----------------------|------------|---|------------|------|
|                                                                                                                                                                                                                                                 |                                                                                                                         |                       | L          | T | P          |      |
| 240E624                                                                                                                                                                                                                                         | BasicsofHardwareDescription Languages                                                                                   | OE                    | 3          | 0 | 0          | 3    |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                          |                                                                                                                         | Co-requisiteCourse(s) |            |   |            |      |
| DigitalElectronics                                                                                                                                                                                                                              |                                                                                                                         | -----                 |            |   |            |      |
| CourseOutcome                                                                                                                                                                                                                                   |                                                                                                                         |                       |            |   |            |      |
| Uponcompletionofthecourse,studentsshallhaveabilityto                                                                                                                                                                                            |                                                                                                                         |                       |            |   |            |      |
| C624.1                                                                                                                                                                                                                                          | Apply digital logic concepts to build circuits                                                                          |                       |            |   |            | [AP] |
| C624.2                                                                                                                                                                                                                                          | Build Programmable devices and learn VLSI withFPGA.                                                                     |                       |            |   |            | [AP] |
| C624.3                                                                                                                                                                                                                                          | Construct modules using basic HDL concepts.                                                                             |                       |            |   |            | [AP] |
| C624.4                                                                                                                                                                                                                                          | Construct modules using advanced HDL concepts.                                                                          |                       |            |   |            | [AP] |
| C624.5                                                                                                                                                                                                                                          | Build various digital circuits using Verilog.                                                                           |                       |            |   |            | [AP] |
| CourseContents                                                                                                                                                                                                                                  |                                                                                                                         |                       |            |   |            |      |
| Unit -1                                                                                                                                                                                                                                         | DIGITALLOGIC                                                                                                            |                       |            |   |            | 9    |
| Numbersystem, Boolean theorem- logicgates,Simplificationoflogicfunction-Combinationalcircuits-Adder,subtractor, Encoder, decoder, multiplexer, demultiplexer.Sequential circuits- latch, flip-flop,counter.                                     |                                                                                                                         |                       |            |   |            |      |
| Unit - 2                                                                                                                                                                                                                                        | PROGRAMMABLEDIGITALICS                                                                                                  |                       |            |   |            | 9    |
| IntroductiontoVLSI-Evolutionof VLSI Systems-Applicationsof VLSI Systems-ProgrammableLogicDevices - ROM, PAL, PLA - CPLD- Introduction toFPGA- DigitalICdesignflow                                                                               |                                                                                                                         |                       |            |   |            |      |
| Unit -3                                                                                                                                                                                                                                         | VERILOGHDL                                                                                                              |                       |            |   |            | 9    |
| Introduction to HDL- LexicalConventions- Ports and Modules-DataTypes-DataFlowModeling-Operators- Gate LevelModeling                                                                                                                             |                                                                                                                         |                       |            |   |            |      |
| Unit - 4                                                                                                                                                                                                                                        | ADVANCEDVERILOGHDL                                                                                                      |                       |            |   |            | 9    |
| BehaviorallevelModelling-Synthesisof Finite StateMachines-SwitchLevelModelling-SystemTasks&Compiler Directives - Test benches                                                                                                                   |                                                                                                                         |                       |            |   |            |      |
| Unit -5                                                                                                                                                                                                                                         | SYSTEMDESIGNUSINGVERILOGHDL                                                                                             |                       |            |   |            | 9    |
| Design ofCombinational circuits-Multiplexers / Demultiplexers, Magnitude comparators, Adders-Multiplier-Divider. Design ofSequential circuits- Flip flops, Registers /Shift registers,counters - Statemachines-Patternsequence detector design. |                                                                                                                         |                       |            |   |            |      |
|                                                                                                                                                                                                                                                 |                                                                                                                         |                       |            |   | TotalHours | 45   |
| Textbooks:                                                                                                                                                                                                                                      |                                                                                                                         |                       |            |   |            |      |
| 1                                                                                                                                                                                                                                               | M.MorrisMano, MichaelDCiletti, DigitalDesign, 4theditionPearson, 2011                                                   |                       |            |   |            |      |
| 2                                                                                                                                                                                                                                               | Samir Palnitkar,Verilog HDL, Pearson Education, 2nd Edition, 2004.                                                      |                       |            |   |            |      |
| ReferenceBooks:                                                                                                                                                                                                                                 |                                                                                                                         |                       |            |   |            |      |
| 1                                                                                                                                                                                                                                               | Stephen Brown and Zvonko Vranesic,Fundamentals ofDigital Logic with Verilog Design, 3rd Edition, Tata McGraw Hill, 2014 |                       |            |   |            |      |
| 2                                                                                                                                                                                                                                               | Bob Zeidman, Designing with FPGAs and CPLDs, Elsevier, CMP Books, 2002                                                  |                       |            |   |            |      |
| 3                                                                                                                                                                                                                                               | Ion Grout, DigitalSystems Design with FPGAs and CPLDs, Elsevier,2008                                                    |                       |            |   |            |      |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                                                    |                       |                   |                         | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand                                                  | 20%                   | 20%               | 20%                     |            |            |                          |
| Apply                                                       | 80%                   | 80%               | 80%                     |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P010 | P011 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| C624.1      | 3   | 3   | 2   |     |     |     |     |     |     |      |      |
| C624.2      | 3   | 3   | 2   |     |     |     |     |     |     |      |      |
| C624.3      | 3   | 3   | 2   |     | 3   |     |     |     |     |      | 2    |
| C624.4      | 3   | 3   | 2   |     |     |     |     |     |     |      | 2    |
| C624.5      | 3   | 3   | 2   |     |     |     |     |     |     |      | 2    |

| Course Code              | Course Name                                                       | Category | Hours/Week |   |   | C   |
|--------------------------|-------------------------------------------------------------------|----------|------------|---|---|-----|
|                          |                                                                   |          | L          | T | P |     |
| 240E625                  | Introduction to Internet of Things                                | OE       | 3          | 0 | 0 | 3   |
| <b>Course Objectives</b> |                                                                   |          |            |   |   | RBT |
| C625.1                   | Explain the concept of IoT                                        |          |            |   |   | U   |
| C625.2                   | Understand the communication models and various protocols for IoT |          |            |   |   | U   |
| C625.3                   | Design portable IoT using Arduino/Raspberry Pi /open platform     |          |            |   |   | AP  |
| C625.4                   | Apply data analytics and use cloud offerings related to IoT       |          |            |   |   | AP  |
| C625.5                   | Analyze applications of IoT in real time scenario                 |          |            |   |   | AN  |

| CourseContent                                                                                                                                                                                                     |                                                                                                                                                                                              |                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
|                                                                                                                                                                                                                   |                                                                                                                                                                                              |                 |
| Unit – I                                                                                                                                                                                                          | INTRODUCTION TO INTERNET OF THINGS                                                                                                                                                           | 9               |
| Evolution ofInternet ofThings – Enabling Technologies – IoT Architectures: oneM2M, IoT WorldForum(IoTWF)andAlternative IoT Models –Simplified IoT Architecture and CoreIoTFunctionalStack – Fog,EdgeandCloudinIoT |                                                                                                                                                                                              |                 |
| Unit – II                                                                                                                                                                                                         | COMPONENTS IN INTERNET OF THINGS                                                                                                                                                             | 9               |
| Functional Blocks ofan IoT Ecosystem –Sensors, Actuators, andSmart Objects –Control Units- Communicationmodules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules)                                                        |                                                                                                                                                                                              |                 |
| Unit – III                                                                                                                                                                                                        | PROTOCOLS AND TECHNOLOGIES BEHIND IOT                                                                                                                                                        | 9               |
| IOT Protocols – IPv6, 6LoWPAN, MQTT, CoAP- RFID, WirelessSensor Networks,BigDataAnalytics,CloudComputing, EmbeddedSystems.                                                                                        |                                                                                                                                                                                              |                 |
| Unit – IV                                                                                                                                                                                                         | OPEN PLATFORMS AND PROGRAMMING                                                                                                                                                               | 9               |
| IOT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins –Sending and Receiving Signals Using GPIO Pins – Connecting totheCloud.                           |                                                                                                                                                                                              |                 |
| Unit – V                                                                                                                                                                                                          | IOT APPLICATIONS                                                                                                                                                                             | 9               |
| Business models for the internet ofthings,Smart city,Smart mobility andtransport,IndustrialIoT,Smartealth,Environment monitoring and surveillance – Home Automation –Smart Agriculture                            |                                                                                                                                                                                              |                 |
|                                                                                                                                                                                                                   |                                                                                                                                                                                              | TOTAL: 45 Hours |
| Learning Resources                                                                                                                                                                                                |                                                                                                                                                                                              |                 |
| Text Books                                                                                                                                                                                                        |                                                                                                                                                                                              |                 |
| 1                                                                                                                                                                                                                 | Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, GonzaloSalgueiro,“IoT Fundamentals:Networking Technologies, Protocols, and Use Cases for the InternetofThings”,CISCOPress,2017 |                 |
| 2                                                                                                                                                                                                                 | SamuelGreengard, TheInternetofThings, TheMITPress, 2015                                                                                                                                      |                 |
| Reference Books                                                                                                                                                                                                   |                                                                                                                                                                                              |                 |
| 1                                                                                                                                                                                                                 | PerryLea, “Internetofthingsforarchitects”,Packt,2018                                                                                                                                         |                 |
| 2                                                                                                                                                                                                                 | Olivier Hersent, David Boswarthick, Omar Elloumi , “TheInternetofThings – Keyapplicationsand Protocols”, Wiley, 2012                                                                         |                 |
| 3                                                                                                                                                                                                                 | IOT (Internet ofThings) Programming: A Simple and FastWayofLearning,IOTKindleEdition.                                                                                                        |                 |
| 4                                                                                                                                                                                                                 | Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet ofThings”, Springer, 2011.                                                                           |                 |
| 5                                                                                                                                                                                                                 | ArshdeepBahga, Vijay Madisetti, “Internet ofThings – A hands-on approach”, Universities Press, 2015                                                                                          |                 |
| Web References                                                                                                                                                                                                    |                                                                                                                                                                                              |                 |
| 1                                                                                                                                                                                                                 | <a href="https://www.arduino.cc/">https://www.arduino.cc/</a>                                                                                                                                |                 |
| 2                                                                                                                                                                                                                 | <a href="https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet">https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet</a>                                                        |                 |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                                                    | 20%                   |                   |                         | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand                                                  | 80%                   | 20%               | 40%                     |            |            |                          |
| Apply                                                       |                       | 80%               | 60%                     |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P010 | P011 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| C625.1      | 2   | 2   | 1   |     |     |     |     |     |     |      |      |
| C625.2      | 2   | 2   | 1   |     |     |     |     |     |     |      | 1    |
| C625.3      | 3   | 3   | 2   |     |     |     |     |     |     |      | 1    |
| C625.4      | 3   | 3   | 2   |     |     |     |     |     |     |      | 1    |
| C625.5      | 3   | 3   | 2   |     |     |     |     |     |     |      | 1    |

**OPEN ELECTIVES OFFERED BY EEE**

| Course Code                                                                                                                                                                                                                                                                                                                                         | CourseName                                                                                                                                                                                    | Category | Hours/Week |   |   | C   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------|---|---|-----|
|                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                               |          | L          | T | P |     |
| 24OE626                                                                                                                                                                                                                                                                                                                                             | IndustrialAutomation With PLC and SCADA                                                                                                                                                       | OE       | 3          | 0 | 0 | 3   |
| CourseOutcomes(s)                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                               |          |            |   |   |     |
| Uponcompletionofthecourse, studentsshallhaveabilityto                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                               |          |            |   |   | RBT |
| C626.1                                                                                                                                                                                                                                                                                                                                              | Understandtheintegratedindustrialautomationsystem.                                                                                                                                            |          |            |   |   | U   |
| C626.2                                                                                                                                                                                                                                                                                                                                              | IdentifythePLChardwareandprogramminglanguagesforvariousapplications.                                                                                                                          |          |            |   |   | U   |
| C626.3                                                                                                                                                                                                                                                                                                                                              | Develop PLC ladder logic programming for industrial problems.                                                                                                                                 |          |            |   |   | AP  |
| C626.4                                                                                                                                                                                                                                                                                                                                              | Impart the knowledge about SCADA and understand the components of SCADA.                                                                                                                      |          |            |   |   | U   |
| C626.5                                                                                                                                                                                                                                                                                                                                              | Apply PLC and SCADA in real time applications to meet industrial automation.                                                                                                                  |          |            |   |   | AP  |
| CourseContent                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                               |          |            |   |   |     |
| Unit-I                                                                                                                                                                                                                                                                                                                                              | INTRODUCTION                                                                                                                                                                                  |          |            |   |   | 9   |
| ArchitectureofthebasicthreelevelIntegratedIndustrialAutomationSystems–Fieldlevelforsensors actuatorsandsmartdevices,Controllevelforprocessandmotioncontrolfunctions,Distributedcontrolsyste m-SupervisorylevelforDataloggingandAcquisitionsystems–DASandSCADAforManagement functions – Integratedautomationthroughbusstructureatthedifferentlevels. |                                                                                                                                                                                               |          |            |   |   |     |
| Unit-II                                                                                                                                                                                                                                                                                                                                             | INTRODUCTIONTOPROGRAMMABLELOGICCONTROLLER                                                                                                                                                     |          |            |   |   | 9   |
| Overview of Programmable Logic Controller – Architecture – Principleof operation–I/O Modules:Discrete, Analog, Special–I/OSpecifications–CPU –Memory design andtypes– Programmingdevices–Recording and Retrieving data–PLC programming languages.IntroductiontoHumanMachineInterfaces(HMI).                                                         |                                                                                                                                                                                               |          |            |   |   |     |
| Unit-III                                                                                                                                                                                                                                                                                                                                            | BASICPLCPROGRAMMING                                                                                                                                                                           |          |            |   |   | 9   |
| Fundamentalsof Logic–ProgramScan–Relay–TypeInstructions–Instructionaddressing–Branchand Internal relay instructions – Entering the Ladder diagram–ElectromagneticControlrelays– Contactors– MotorStarters – ManualoperatedswitchesandMechanicallyoperatedswitches.                                                                                  |                                                                                                                                                                                               |          |            |   |   |     |
| Unit-IV                                                                                                                                                                                                                                                                                                                                             | SCADA                                                                                                                                                                                         |          |            |   |   | 9   |
| Introduction to SCADA – A brief history of SCADA – Real-time systems –Remote control– Communications: communication systemcomponents – protocol-modems– Remote terminalunits(RTUs) – Master terminal units(MTUs).                                                                                                                                   |                                                                                                                                                                                               |          |            |   |   |     |
| Unit-V                                                                                                                                                                                                                                                                                                                                              | APPLICATIONSOFSCADA                                                                                                                                                                           |          |            |   |   | 9   |
| Applications:RealtimeRevisited –Accounting andgradeofdata–Scanningandcommunications – Automatic control. Applications SCADA for Power Utility Network.                                                                                                                                                                                              |                                                                                                                                                                                               |          |            |   |   |     |
| TotalHours                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                               |          |            |   |   | 45  |
| LearningResources                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                               |          |            |   |   |     |
| Textbooks                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                               |          |            |   |   |     |
| 1                                                                                                                                                                                                                                                                                                                                                   | Krishnaswamy K, “Process Control”, 2nd Edition, New Age International(P) Ltd,NewDelhi,2015.                                                                                                   |          |            |   |   |     |
| 2                                                                                                                                                                                                                                                                                                                                                   | Frank D. Petruzella,"Programmable Logic Controllers", 5th Edition, Tata McGraw-Hill , NewDelhi, 2019.                                                                                         |          |            |   |   |     |
| 3                                                                                                                                                                                                                                                                                                                                                   | Stuart A. Boyer, “SCADA: Supervisory Control and Data Acquisition”, 4th Edition, ISA Press,USA, 2009.                                                                                         |          |            |   |   |     |
| ReferenceBooks                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                               |          |            |   |   |     |
| 1                                                                                                                                                                                                                                                                                                                                                   | Webb John W & Reis Ronald A, "Programmable Logic Controllers –Principlesand Applications",5th Edition, PHI Learning Private Limited, NewDelhi,2002.                                           |          |            |   |   |     |
| 2                                                                                                                                                                                                                                                                                                                                                   | Bolton W, “Programmable Logic Controllers”, 5th Edition, Elsevie , New York, 2009.                                                                                                            |          |            |   |   |     |
| WebReferences                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                               |          |            |   |   |     |
| 1                                                                                                                                                                                                                                                                                                                                                   | <a href="https://www.nielit.gov.in/calicut/content/online-course-industrial-automation-plc-scada">https://www.nielit.gov.in/calicut/content/online-course-industrial-automation-plc-scada</a> |          |            |   |   |     |
| 2                                                                                                                                                                                                                                                                                                                                                   | <a href="https://www.nielit.gov.in/calicut/content/iad102">https://www.nielit.gov.in/calicut/content/iad102</a>                                                                               |          |            |   |   |     |

| Course Code                                                   | Course Name                                                                                  | Category | Hours/Week |   |   | C   |
|---------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------|------------|---|---|-----|
|                                                               |                                                                                              |          | L          | T | P |     |
| 240E627                                                       | Electric Vehicle Technology                                                                  | OE       | 3          | 0 | 0 | 3   |
| <b>Course Outcomes(s)</b>                                     |                                                                                              |          |            |   |   |     |
| Upon completion of the course, students shall have ability to |                                                                                              |          |            |   |   | RBT |
| C627.1                                                        | Summarize about the sustainable transportation through electric vehicle systems              |          |            |   |   | U   |
| C627.2                                                        | Design and select EV drive for the desirable performance and control                         |          |            |   |   | U   |
| C627.3                                                        | Explain the architecture of various types of hybrid vehicles.                                |          |            |   |   | U   |
| C627.4                                                        | Apply the various control strategies of series & Parallel HEVs using DC and AC Motor drives. |          |            |   |   | AP  |
| C62.75                                                        | Examine about the battery technologies for Electric vehicle charging schemes.                |          |            |   |   | AP  |

| CourseContent                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                |    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Unit-I                                                                                                                                                                                                                                                                                                                                                                                 | INTRODUCTION TOELECTRIC VEHICLES                                                                                                                                               | 9  |
| SustainableTransportation–EVSystem–EVAdvantages–VehicleMechanics–PerformanceofEVs– ElectricVehicledrivetrain–EVTransmissionConfigurationsandcomponents– TractiveEffortinNormalDriving–EnergyConsumption–EV Market– Typesof Electric Vehicle inUseToday– Electric Vehiclesforthe Future                                                                                                 |                                                                                                                                                                                |    |
| Unit- II                                                                                                                                                                                                                                                                                                                                                                               | ELECTRIC VEHICLEDESIGNCONSIDERATIONS                                                                                                                                           | 9  |
| GeneralDescriptionof VehicleMovement- VehicleResistance–DynamicEquation- PowerTrainTractiveEffortandVehicleSpeed-VehiclePowerPlantandTransmissionCharacteristics- VehiclePerformance-Brake Performance - EV configurations – General and Typical EVconfigurations- EVparameters                                                                                                        |                                                                                                                                                                                |    |
| Unit-III                                                                                                                                                                                                                                                                                                                                                                               | HYBRID TRACTION                                                                                                                                                                | 9  |
| Basicconceptofhybridtraction, Introductiontovarioushybriddrive-traintopologies–powerflowcontrols inhybriddrive-traintopologies–Basicconceptofelectrictraction-Introductiontovariouselectricdrive- traintopologies- fuelefficiencyanalysis.                                                                                                                                             |                                                                                                                                                                                |    |
| Unit-IV                                                                                                                                                                                                                                                                                                                                                                                | HYBRID VEHICLECONTROL STRATEGY                                                                                                                                                 | 9  |
| Vehicle Supervisory Controller- Mode Selection Strategy -Mechanical Power-Split Hybrid Modes- Series-Parallel Hybrid Modes - Modal Control Strategies - IntroductiontoElectricComponents&DrivesusedinHybrid and Electric vehicles, Configuration and control of DC Motor drives –configurationandcontrolofAC Motor drives, Configuration and control of Switch Reluctance Motor drive. |                                                                                                                                                                                |    |
| Unit-V                                                                                                                                                                                                                                                                                                                                                                                 | BATTERY TECHNOLOGIESFORELECTRIC VEHICLE                                                                                                                                        | 9  |
| Introduction - Power and Energy of Electric Propulsion - Basic Terms of Battery Performance and Characterization - Battery Charging Methods and EVChargingSchemes:ChargingMethods- EVChargingSchemes - Basic Operation ofa Rechargeable Battery - BatteryModeling-CurrentStatusof Battery in Automobile Applications.                                                                  |                                                                                                                                                                                |    |
| TotalHours                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                | 45 |
| LearningResources                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                |    |
| Textbooks                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                      | Mehrdad Ehsani,Yimin Gao and Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel CellVehicles:Fundamentals,Theory,andDesign",2ndEdition,CRCpress,Florida,UnitedStates,2010. |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                      | Sira- Ramirez,Silva.ROrtigoza,"ControlDesignTechniquesinPowerElectronicsDevices",1stEdition, Springer, New York, 2006.                                                         |    |
| ReferenceBooks                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                      | IqbalHussain,"ElectricandHybridVehicles:DesignFundamentals",2ndEdition,CRCpress, Taylor&Francis Group, Florida, United States, 2011.                                           |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                      | ChanC.C.andChauK.T.,"Modernelectricvehicletechnology",1stEdition,OxfordUniversityPress, New York, 2001.                                                                        |    |
| WebReferences                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                      | <a href="https://onlinecourses.nptel.ac.in/noc20_ee18/preview">https://onlinecourses.nptel.ac.in/noc20_ee18/preview</a>                                                        |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                      | <a href="https://www.coursera.org/learn/electric-vehicles-mobility">https://www.coursera.org/learn/electric-vehicles-mobility</a>                                              |    |



| Course Code                                                   | Course Name                                                                                                                                                                                                          | Category | Hours/Week |   |   | C   |
|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------|---|---|-----|
|                                                               |                                                                                                                                                                                                                      |          | L          | T | P |     |
| 24OE628                                                       | Energy Technology                                                                                                                                                                                                    | OE       | 3          | 0 | 0 | 3   |
| <b>Course Outcomes(s)</b>                                     |                                                                                                                                                                                                                      |          |            |   |   |     |
| Upon completion of the course, students shall have ability to |                                                                                                                                                                                                                      |          |            |   |   | RBT |
| C628.1                                                        | Describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.                                                                                       |          |            |   |   | U   |
| C628.2                                                        | Excel as professionals in the various fields of energy engineering                                                                                                                                                   |          |            |   |   | U   |
| C628.3                                                        | Compare different renewable energy technologies and choose the most appropriate based on local conditions.                                                                                                           |          |            |   |   | U   |
| C628.4                                                        | Explain the technological basis for harnessing renewable energy sources.                                                                                                                                             |          |            |   |   | U   |
| C628.5                                                        | Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level. |          |            |   |   | U   |

| CourseContent                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                         |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|----|
| Unit-I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | INTRODUCTION                                                                                                            | 8  |
| Unitsofenergy,conversionfactors,generalclassificationofenergy,worldenergyresourcesandenergy consumption, Indianenergyresourcesandenergyconsumption, energycrisis, energyalternatives,Renewableandnon-renewableenergysourcesandtheiravailability. ProspectsofRenewableenergy sources                                                                                                                                                                                                                 |                                                                                                                         |    |
| Unit- II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | CONVENTIONALENERGY                                                                                                      | 8  |
| Conventionalenergyresources,Thermal,hydelandnuclearreactors,thermal,hydelandnuclearpowerplan ts,efficiency,meritsanddemeritsoftheabovepowerplants,combustionprocesses,fluidizedbed combustion.                                                                                                                                                                                                                                                                                                      |                                                                                                                         |    |
| Unit-III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | NON-CONVENTIONALENERGY                                                                                                  | 10 |
| Solarenergy,solarthermalsystems,flatplatecollectors,focusingcollectors,solarwaterheating,solarcool ing,solardistillation,solarrefrigeration,solardryers,solarpond,solarthermalpowergeneration, solarenergyapplicationinIndia, energyplantations. Windenergy, typesofwindmills, typesofwindrotors, DarrieusrotorandGravianrotor, windelectricpowergeneration, windpowerinIndia,economicsofwind farm,oceanwaveenergyconversion,oceanthermalenergyconversion,tidalenergyconversion, geothermal energy. |                                                                                                                         |    |
| Unit-IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | BIOMASSENERGY                                                                                                           | 10 |
| Biomassenergyresources, thermo- chemicalandbiochemicalmethodsofbiomassconversion,combustion, gasification,Pyrolysis,biogasproduction,ethanol,fuelcells,alkalinefuelcell,phosphoricacidfuelcell, moltencarbonatefuelcell,solidoxidefuelcell,solidpolymerelectrolytefuelcell,magnetohydrodynamic powergeneration,energystoragerouteslikethermalenergystorage,chemical,mechanicalstorageand electricalstorage.                                                                                         |                                                                                                                         |    |
| Unit-V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ENERGYCONSERVATION                                                                                                      | 9  |
| Energyconservationinchemicalprocessplants, energyaudit,energysavinginheatexchangers,distillation columns, dryers, ovensandfurnacesandboilers, steameconomyinchemicalplants, energyconservation                                                                                                                                                                                                                                                                                                      |                                                                                                                         |    |
| TotalHours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                         | 45 |
| LearningResources                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                         |    |
| Textbooks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                         |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.                                                |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, NewDelhi,1984.                                           |    |
| ReferenceBooks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                         |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Bansal, N.K., Kleeman, M. and Meliss, M., RenewableEnergy SourcesandConversionTechnology,Tata McGraw Hill,1990.         |    |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | El. Wakil, Power Plant Technology, Tata McGraw Hill,New York,2002.                                                      |    |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.                                                         |    |
| WebReferences                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                         |    |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <a href="https://onlinecourses.nptel.ac.in/noc24_ge51/preview">https://onlinecourses.nptel.ac.in/noc24_ge51/preview</a> |    |



| Course Code                                                   | Course Name                                                   | Category | Hours/Week |   |   | C   |
|---------------------------------------------------------------|---------------------------------------------------------------|----------|------------|---|---|-----|
|                                                               |                                                               |          | L          | T | P |     |
| 240E629                                                       | Battery Management Systems                                    | OE       | 3          | 0 | 0 | 3   |
| <b>Course Outcomes(s)</b>                                     |                                                               |          |            |   |   |     |
| Upon completion of the course, students shall have ability to |                                                               |          |            |   |   | RBT |
| C629.1                                                        | Acquire knowledge of different Li-ion Batteries performance.  |          |            |   |   | U   |
| C629.2                                                        | Design a Battery Pack and make related calculations.          |          |            |   |   | U   |
| C629.3                                                        | Demonstrate a Battery Model or Simulation.                    |          |            |   |   | U   |
| C629.4                                                        | Estimate State-of-Charges in a Battery Pack.                  |          |            |   |   | U   |
| C629.5                                                        | Approach different BMS architectures during real world usage. |          |            |   |   | U   |

| CourseContent                                                                                                                                                                                                                                                                      |                                                                                                                                   |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|----|
| Unit-I                                                                                                                                                                                                                                                                             | ADVANCEDBATTERIES                                                                                                                 | 9  |
| Li-ionBatteries-different formats,chemistry, safe operating area,efficiency,aging.Characteristics-SOC,DOD,SOH.Balancing-PassiveBalancing Vs ActiveBalancing.OtherBatteries-NCMandNCABatteries.NCR18650B specifications.                                                            |                                                                                                                                   |    |
| Unit-II                                                                                                                                                                                                                                                                            | BATTERYPACK                                                                                                                       | 9  |
| BatteryPack-design,sizing,calculations,flowchart,realandsimulationModel.Peakpower-definition, testingmethods-relationshipswithPower, TemperatureandohmicInternalResistance.Cloudbasedand LocalSmartcharging.                                                                       |                                                                                                                                   |    |
| Unit-III                                                                                                                                                                                                                                                                           | BATTERYMODELLING                                                                                                                  | 9  |
| Battery Modeling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model.ECMComparisons-Rintmodel,Theveninmodel,PNGVmodel.StatespaceModels-Introduction.BatteryModelling software/simulation frameworks.                                                    |                                                                                                                                   |    |
| Unit-IV                                                                                                                                                                                                                                                                            | BATTERYSTATEESTIMATION                                                                                                            | 9  |
| SOC Estimation- Definition, importance, single cell Vs series batteries SOC. EstimationMethods- Load voltage, Electromotive force, AC impedance, Ah counting, Neural networks, Neuro-fuzzy forecast method,Kalman filter. Estimation Algorithms.                                   |                                                                                                                                   |    |
| Unit-V                                                                                                                                                                                                                                                                             | BMSARCHITECTUREANDREALTIMECOMPONENTS                                                                                              | 9  |
| Battery Management System- needs, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery MonitorIC- CC2662R-Q1 Wireless BMS MCU. Communication Modules-CANOpen-FlexRay-CANedge1 package.<br>ARBIN Battery Tester. BMS Development with Modeling software and Model BasedDesign. |                                                                                                                                   |    |
| TotalHours                                                                                                                                                                                                                                                                         |                                                                                                                                   | 45 |
| LearningResources                                                                                                                                                                                                                                                                  |                                                                                                                                   |    |
| Textbooks                                                                                                                                                                                                                                                                          |                                                                                                                                   |    |
| 1                                                                                                                                                                                                                                                                                  | Jiuchun Jiang and Caiping Zhang, “Fundamentals and applications of Lithium-Ion batteries inElectric Drive Vehicles”, Wiley, 2015. |    |
| 2                                                                                                                                                                                                                                                                                  | Davide Andrea ,“Battery Management Systems for Large Lithium-Ion Battery Packs” ARTECHHouse, 2010.                                |    |
| ReferenceBooks                                                                                                                                                                                                                                                                     |                                                                                                                                   |    |
| 1                                                                                                                                                                                                                                                                                  | DevelopingBatteryManagementSystemswithSimulinkandModel-BasedDesign-whitepaper                                                     |    |
| WebReferences                                                                                                                                                                                                                                                                      |                                                                                                                                   |    |
| 1                                                                                                                                                                                                                                                                                  | <a href="https://nptel.ac.in/courses/113105102">https://nptel.ac.in/courses/113105102</a>                                         |    |
| 2                                                                                                                                                                                                                                                                                  | <a href="https://archive.nptel.ac.in/courses/113/105/113105102/">https://archive.nptel.ac.in/courses/113/105/113105102/</a>       |    |

| Course Code                                                 | Course Name                                                                                                 | Category | Hours/Week |   |   | C   |
|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|----------|------------|---|---|-----|
|                                                             |                                                                                                             |          | L          | T | P |     |
| 24OE630                                                     | Power Converters For Electrical Appliances                                                                  | OE       | 3          | 0 | 0 | 3   |
| <b>Course Outcome(s)</b>                                    |                                                                                                             |          |            |   |   |     |
| Upon completion of the course student shall have ability to |                                                                                                             |          |            |   |   | RBT |
| C630.1                                                      | Understand how different power electronic devices like diodes, SCRs, BJTs, MOSFETs, and IGBTs work.         |          |            |   |   | U   |
| C630.2                                                      | Learn how rectifiers convert AC to DC and how to reduce ripples using filters.                              |          |            |   |   | U   |
| C630.3                                                      | Know how inverters convert DC to AC and where they are used, like in UPS and solar systems.                 |          |            |   |   | U   |
| C630.4                                                      | Understand how DC-DC converters (like buck, boost, and buck-boost) work and where to use them.              |          |            |   |   | U   |
| C630.5                                                      | Learn how power converters are used in smart systems like smart homes, electric vehicles, and solar energy. |          |            |   |   | U   |

| CourseContents                                                                                                                                                                                                                                                                              |                                                                                                                        |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|----|
| Unit-I                                                                                                                                                                                                                                                                                      | IntroductiontoPowerElectronicDevices                                                                                   | 9  |
| Overviewof PowerElectronics–Definition,Need, and ApplicationsPowerSemiconductorDevices–Diodes,Thyristors(SCR),PowerBJT,PowerMOSFET,IGBTSwitchingCharacteristics–Turn-on,Turn-off,LossesBasic Drive Circuits for Power Devices                                                               |                                                                                                                        |    |
| Unit-II                                                                                                                                                                                                                                                                                     | AC–DCConverters(Rectifiers)                                                                                            | 9  |
| IntroductiontoRectifiers–NeedandTypesSingle–PhaseRectifiers–Half-wave,Full-wave(Center-tap& Bridge)Ripple&Smoothing– Whycapacitorsareused(Likefilteringnoiseinsignals)Applications–Laptop adapters, USB chargers, PC power supplies, Applications – Battery Chargers, DC Power Supplies     |                                                                                                                        |    |
| Unit-III                                                                                                                                                                                                                                                                                    | DC–ACConverters(Inverters)                                                                                             | 9  |
| Introduction to Inverters – Need and Types(Voltage Source & CurrentSource)Single-PhaseInverters–Half-bridge, Full-bridge (Square wave & PWM) Applications – UPS, Solar PVSystems,MotorDrives                                                                                                |                                                                                                                        |    |
| Unit-IV                                                                                                                                                                                                                                                                                     | DC–DCConverters(Choppers)                                                                                              | 9  |
| Introduction toDC-DC Converters–NeedandTypesStep–down(Buck)Converter–Operation andWaveformsStep-up(Boost)Converter–OperationandWaveformsBuck-BoostConverter–OperationandApplications–SMPS,ElectricVehicles,LEDDriversApplications–Smartphonefastcharging,LEDdrivers,Laptop power management |                                                                                                                        |    |
| Unit-V                                                                                                                                                                                                                                                                                      | PowerConvertersinSmartSystems                                                                                          | 9  |
| HomeAutomation–Howconvertersworkinsmartbulbs,Wi-Fi switches,Computer&ITSystems–SMPS(SwitchedModePowerSupply) inPCs/DatacenterpowerbackupsystemsRenewableEnergy–Solarinverters, electricvehiclechargingFutureTrends –Alinpowermanagement, IoT-basedenergysaving                              |                                                                                                                        |    |
| TotalHours                                                                                                                                                                                                                                                                                  |                                                                                                                        | 45 |
| Textbooks                                                                                                                                                                                                                                                                                   |                                                                                                                        |    |
| 1                                                                                                                                                                                                                                                                                           | PowerElectronics:Circuits,DevicesandApplications,MuhammadH.Rashid,PearsonEducation,4th Edition, 2017                   |    |
| 2                                                                                                                                                                                                                                                                                           | Power Electronics, P.S. Bimbhra, Khanna Publishers,7th Edition, 2018                                                   |    |
| ReferenceBooks                                                                                                                                                                                                                                                                              |                                                                                                                        |    |
| 1                                                                                                                                                                                                                                                                                           | Power Electronics: Essentials and Applications L. Umanand Wiley India 1st Edition,2009                                 |    |
| 2                                                                                                                                                                                                                                                                                           | PowerElectronics:Converters, Applications andDesign,NedMohan,ToreM.Undeland,WilliamP. Robbins, Wiley, 3rd Edition,2002 |    |
| WebReferences                                                                                                                                                                                                                                                                               |                                                                                                                        |    |

|   |                                                                                                                                                           |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <a href="https://nptel.ac.in/courses/108/105/108105066/">https://nptel.ac.in/courses/108/105/108105066/</a>                                               |
| 2 | <a href="https://www.allaboutcircuits.com/technical-articles/categories/power/">https://www.allaboutcircuits.com/technical-articles/categories/power/</a> |

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Course Name                                                                                                                                                                | Category               | Hours/Week                |   |   | C    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                            |                        | L                         | T | P |      |
| 24OE631                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | FOUNDATION OF ROBOTICS                                                                                                                                                     | OE                     | 3                         | 0 | 0 | 3    |
| Regulation R24                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Nature of the Course                                                                                                                                                       | Semester               | Data Book/Codes/Standards |   |   |      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | THEORY                                                                                                                                                                     |                        | -----                     |   |   |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                            | Co-requisite Course(s) |                           |   |   |      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                            |                        |                           |   |   |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                            |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | To study the kinematics, drive systems and programming of robots.                                                                                                          |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | To study the basics of robot laws and transmission systems.                                                                                                                |                        |                           |   |   |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | To familiarize students with the concepts and techniques of robot manipulator, its kinematics.                                                                             |                        |                           |   |   |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | To familiarize students with the various Programming and Machine Vision application in robots.                                                                             |                        |                           |   |   |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | To build confidence among students to evaluate, choose and incorporate robots in engineering systems.                                                                      |                        |                           |   |   |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                            |                        |                           |   |   |      |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                            |                        |                           |   |   |      |
| C631.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Interpret the features of robots and technology involved in the control.                                                                                                   |                        |                           |   |   | [U]  |
| C631.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Apply basic engineering knowledge and relevant laws for the design of robotics.                                                                                            |                        |                           |   |   | [AP] |
| C631.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Apply the concepts of various configurations, classifications, and parts of end effectors to compare different end effectors, grippers, tools, and sensors used in robots. |                        |                           |   |   | [AP] |
| C631.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Apply the principles of kinematics, degeneracy, dexterity, and trajectory planning in robotics applications.                                                               |                        |                           |   |   | [AP] |
| C631.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Apply image processing and image analysis techniques using a machine vision system.                                                                                        |                        |                           |   |   | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit -1                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | FUNDAMENTALS OF ROBOT                                                                                                                                                      |                        |                           |   |   | 9    |
| Robot Definition, Robot Anatomy Co-ordinates systems, Work Envelope, classification-Requirements-Pitch, yaw, Roll, Joint Notations, Speed of Motion, Payload -Need for Robots- Applications.                                                                                                                                                                                                                                                                                   |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit -2                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ROBOT KINEMATICS                                                                                                                                                           |                        |                           |   |   | 9    |
| Forward kinematics, inverse kinematics and the difference-two and three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional). Homogeneous transformation matrices, translation and rotation matrices.                                                                                                                                                                                                                                             |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit -3                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ROBOT DRIVE SYSTEMS AND END EFFECTORS                                                                                                                                      |                        |                           |   |   | 9    |
| Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives: D.C. Servo Motors, Stepper Motor, A.C. Servo Motors-Applications and Comparison. End Effectors- Grippers: Mechanical, Pneumatic and Hydraulic, Magnetic, vacuum, internal and external grippers- selection and design considerations of a gripper.                                                                                                                                                      |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit -4                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | SENSORS IN ROBOTICS                                                                                                                                                        |                        |                           |   |   | 9    |
| Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors for hazardous environment and compliance mechanism. Machine vision system, frame grabber, sensing and digitizing image data signal conversion, image storage, lighting techniques, image processing and analysis - data reduction, segmentation, feature extraction, object recognition and other algorithms. Applications, Inspection, safety considerations, visual serving and navigation. |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit -5                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | PROGRAMMING AND APPLICATIONS OF ROBOT                                                                                                                                      |                        |                           |   |   | 9    |
| Teach pendant programming, lead through programming, robot programming languages- commands for Motion, Sensors and End-Effector. Robot applications for inspection, assembly, material handling, underwater, space and medical fields.                                                                                                                                                                                                                                         |                                                                                                                                                                            |                        |                           |   |   |      |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                            |                        |                           |   |   | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                            |                        |                           |   |   |      |

|   |                                                                             |
|---|-----------------------------------------------------------------------------|
| 1 | Ganesh.S.Hedge, "AtextbookofIndustrialRobotics", LakshmiPublications, 2022. |
|---|-----------------------------------------------------------------------------|

|                        |                                                                                                                                                                 |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2                      | Mikell.P.Groover, "IndustrialRoboticsMcGrawHill 2NDedition2012.Technology,Programming and applications"                                                         |
| 3                      |                                                                                                                                                                 |
| <b>ReferenceBooks:</b> |                                                                                                                                                                 |
| 1                      | Fu K.S. Gonalz R.C. and ice C.S.G."RoboticsControl,Sensing, Vision andIntelligence". McGraw Hill book co.2007                                                   |
| 2                      | YoramKoren, "RoboticsforEngineers", McGrawHillBook,Co.,2002.                                                                                                    |
| 3                      | JanakiramanP.A., "RoboticsandImageProcessing", TataMcGrawHill2005.                                                                                              |
| 4                      | John. J.Craig, "IntroductiontoRobotics: MechanicsandControl" 2ndEdition,2002.                                                                                   |
| 5                      | Jazar, "TheoryofApplied Robotics: Kinematics, Dynamics and Control",SpringerIndia reprint, 2010.                                                                |
| <b>WebReferences:</b>  |                                                                                                                                                                 |
| 1                      | <a href="https://www.barnesandnoble.com/w/foundations-of-robotics-bruno-siciliano">https://www.barnesandnoble.com/w/foundations-of-robotics-bruno-siciliano</a> |
| 2                      | <a href="https://www.foundations-of-robotics.org/?utm_source=chatgpt.com">https://www.foundations-of-robotics.org/?utm_source=chatgpt.com</a>                   |

**AssessmentbasedonContinuousandEndSemesterExamination**

| Bloom'sLevel           | ContinuousAssessment |                  |                       | Assignm<br>ent | Attenda<br>nce | EndSemester<br>Examination |
|------------------------|----------------------|------------------|-----------------------|----------------|----------------|----------------------------|
|                        | CIA1<br>(6Marks)     | CIA2<br>(6Marks) | ModelExam<br>(8Marks) |                |                |                            |
| Remember               |                      |                  |                       | (10<br>Marks)  | (10<br>Marks)  | (60Marks)                  |
| Understand             | 4                    | 2                | 2                     |                |                |                            |
| Apply                  | 2                    | 4                | 6                     |                |                |                            |
| Analyze                |                      |                  |                       |                |                |                            |
| Evaluate               |                      |                  |                       |                |                |                            |
| Create                 |                      |                  |                       |                |                |                            |
| <b>Total(100Marks)</b> | <b>6</b>             | <b>6</b>         | <b>8</b>              | <b>10</b>      | <b>10</b>      | <b>60</b>                  |

- CIA1, CIA2 andModelExamwillbeconductedfor50,50and100marks.Itshallbesubsequently converted to 6, 6 and 8 marks respectively.
- TheAssignmentmarkswillbecomputedbasedonAssignmentI, AssignmentIIandAssignmentIIImarks convertedto10 Marks.
- BTL mark split up may vary based on the natureofthesubject.

| C0s/<br>P0s | P0<br>1 | P0<br>2 | P0<br>3 | P0<br>4 | P0<br>5 | P0<br>6 | P0<br>7 | P0<br>8 | P0<br>9 | P01<br>0 | P01<br>1 | P01<br>2 | PS0<br>1 | PS0<br>2 | PS03 |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|------|
| C631.1      | ✓       | ✓       |         | ✓       | ✓       |         |         |         |         | ✓        |          | ✓        | ✓        | ✓        |      |
| C631.2      | ✓       | ✓       |         | ✓       | ✓       |         |         |         |         | ✓        |          | ✓        | ✓        | ✓        |      |
| C631.3      | ✓       | ✓       |         | ✓       | ✓       |         |         |         |         | ✓        |          | ✓        | ✓        | ✓        |      |
| C631.4      | ✓       | ✓       |         | ✓       | ✓       |         |         |         |         | ✓        |          | ✓        | ✓        | ✓        |      |
| C631.5      | ✓       | ✓       |         | ✓       | ✓       |         |         |         |         | ✓        |          | ✓        | ✓        | ✓        |      |

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                         | Course Name                                                                                                                                                                                              | Category               | Hours/Week                |   |   | C   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|-----|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                          |                        | L                         | T | P |     |
| 24OE632                                                                                                                                                                                                                                                                                                                                                                                                                                             | BASICS OF DRONE TECHNOLOGY                                                                                                                                                                               | OE                     | 3                         | 0 | 0 | 3   |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                          | Nature of the Course                                                                                                                                                                                     | Semester               | Data Book/Codes/Standards |   |   |     |
| R24                                                                                                                                                                                                                                                                                                                                                                                                                                                 | THEORY                                                                                                                                                                                                   |                        | -----                     |   |   |     |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                          | Co-requisite Course(s) |                           |   |   |     |
| Nil                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                          | Nil                    |                           |   |   |     |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                          |                        |                           |   |   |     |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                   | To understand the basics of drone concepts                                                                                                                                                               |                        |                           |   |   |     |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                   | To learn and understand the fundamentals of design, fabrication and programming of drone                                                                                                                 |                        |                           |   |   |     |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                   | To impart the knowledge of a flying and operation of drone                                                                                                                                               |                        |                           |   |   |     |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                   | To know about the various applications of drone                                                                                                                                                          |                        |                           |   |   |     |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                   | To understand the safety risks and guidelines of flying safely                                                                                                                                           |                        |                           |   |   |     |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                          |                        |                           |   |   |     |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                          |                        |                           |   |   |     |
| C101.1                                                                                                                                                                                                                                                                                                                                                                                                                                              | Know about a various type of drone technology, drone fabrication and programming.                                                                                                                        |                        |                           |   |   | [U] |
| C101.2                                                                                                                                                                                                                                                                                                                                                                                                                                              | Execute the suitable operating procedures for functioning a drone                                                                                                                                        |                        |                           |   |   | [U] |
| C101.3                                                                                                                                                                                                                                                                                                                                                                                                                                              | Select appropriate sensors and actuators for Drones                                                                                                                                                      |                        |                           |   |   | [U] |
| C101.4                                                                                                                                                                                                                                                                                                                                                                                                                                              | Develop a drone mechanism for specific applications                                                                                                                                                      |                        |                           |   |   | [U] |
| C101.5                                                                                                                                                                                                                                                                                                                                                                                                                                              | Create the programs for various drones                                                                                                                                                                   |                        |                           |   |   | [U] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                          |                        |                           |   |   |     |
| Unit -1                                                                                                                                                                                                                                                                                                                                                                                                                                             | INTRODUCTION TO DRONE TECHNOLOGY                                                                                                                                                                         |                        |                           |   |   | 9   |
| Drone Concept-Terminology-History of drone-Overview of the main drone parts-Function of the component parts-Technical characteristics of the Types of current generation of drones based on their method of propulsion-Operation of drone. Classification of the UAV.                                                                                                                                                                               |                                                                                                                                                                                                          |                        |                           |   |   |     |
| Unit -2                                                                                                                                                                                                                                                                                                                                                                                                                                             | DRONE DESIGN, FABRICATION AND PROGRAMMING                                                                                                                                                                |                        |                           |   |   | 9   |
| Assembling a drone - The energy sources- Types of autonomy-Drones configurations-methods of programming-programming, compiling and uploading - data collection - Wi-Fi connection.                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                          |                        |                           |   |   |     |
| Unit -3                                                                                                                                                                                                                                                                                                                                                                                                                                             | DRONE OPERATION                                                                                                                                                                                          |                        |                           |   |   | 9   |
| Flight modes- Operation in a controlled environment- Drone controls-Multirotor stabilization-management tools:Sensors, Onboard storage, control system-Removable storage devices - Linked devices and applications.                                                                                                                                                                                                                                 |                                                                                                                                                                                                          |                        |                           |   |   |     |
| Unit -4                                                                                                                                                                                                                                                                                                                                                                                                                                             | DRONE COMMERCIAL APPLICATIONS                                                                                                                                                                            |                        |                           |   |   | 9   |
| Selection of a drone based on the application-Drones in the insurance sector-Drones in delivering parcels and other cargo-Drones in agriculture-Drones in inspection of transmission lines and power distribution-Drones in filming and panoramic picturing.Drones in military applications.Drone technology impact on the businesses -Drone business through entrepreneurship - Opportunities/applications for entrepreneurship and employability. |                                                                                                                                                                                                          |                        |                           |   |   |     |
| Unit -5                                                                                                                                                                                                                                                                                                                                                                                                                                             | FUTURE DRONES AND SAFETY                                                                                                                                                                                 |                        |                           |   |   | 9   |
| The safety risks-Guidelines of flying safely-Specific aviation regulation and standardization-Drone license-Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms.                                                                                                                                                                                                                                                  |                                                                                                                                                                                                          |                        |                           |   |   |     |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                          |                        |                           |   |   |     |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc. |                        |                           |   |   |     |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Terry Kilby and Belinda Kilby, "Make: Getting Started with Drones ", Maker Media, Inc, 2016.                                                                                                             |                        |                           |   |   |     |
| Reference Books:                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                          |                        |                           |   |   |     |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                   | John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016.                                                                                           |                        |                           |   |   |     |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.                                                                             |                        |                           |   |   |     |
| Web References:                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                          |                        |                           |   |   |     |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <a href="https://dronelaunchacademy.com/">https://dronelaunchacademy.com/</a>                                                                                                                            |                        |                           |   |   |     |



|   |                                                                                                                       |
|---|-----------------------------------------------------------------------------------------------------------------------|
| 2 | <a href="https://www.airsight.com/knowledge-hub/drone-basics">https://www.airsight.com/knowledge-hub/drone-basics</a> |
|---|-----------------------------------------------------------------------------------------------------------------------|

| Assessment based on Continuous and End Semester Examination |                       |               |                     |            |            |                          |
|-------------------------------------------------------------|-----------------------|---------------|---------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |               |                     | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1 (6Marks)         | CIA2 (6Marks) | Model Exam (8Marks) |            |            |                          |
| Remember                                                    |                       |               |                     | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand                                                  | 2                     | 2             | 2                   |            |            |                          |
| Apply                                                       | 4                     | 4             | 6                   |            |            |                          |
| Analyze                                                     |                       |               |                     |            |            |                          |
| Evaluate                                                    |                       |               |                     |            |            |                          |
| Create                                                      |                       |               |                     |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>      | <b>8</b>            | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| C0s/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS0 1 | PS0 2 | PS03 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|------|
| C101.1      | ✓    | ✓    |      |      |      | ✓    | ✓    | ✓    |      |       |       | ✓     |       |       |      |
| C101.2      | ✓    | ✓    | ✓    | ✓    |      |      |      |      |      |       |       | ✓     |       |       |      |
| C101.3      | ✓    | ✓    |      |      |      | ✓    | ✓    | ✓    |      |       |       | ✓     |       |       |      |
| C101.4      | ✓    | ✓    | ✓    | ✓    |      |      |      |      |      |       |       | ✓     |       |       |      |
| C101.5      | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |      |      |      |       |       | ✓     |       |       |      |

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Course Name                                                                                                                                                                | Category               | Hours/Week                |   |   | C    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                            |                        | L                         | T | P |      |
| 24OE633                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3DPRINTING                                                                                                                                                                 | PC                     | 3                         | 0 | 0 | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Nature of the Course                                                                                                                                                       | Semester               | Data Book/Codes/Standards |   |   |      |
| R24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Theory                                                                                                                                                                     | OE                     | -----                     |   |   |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                            | Co-requisite Course(s) |                           |   |   |      |
| Computer Aided Design & Drafting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                            | Engineering Materials  |                           |   |   |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                            |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To Know the importance of 3D printing in Manufacturing.                                                                                                                    |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To know the different 3D Printing Technologies.                                                                                                                            |                        |                           |   |   |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To select a suitable material for 3D Printing.                                                                                                                             |                        |                           |   |   |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To observe the different methods for Post-processing of 3D Printing parts.                                                                                                 |                        |                           |   |   |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To Understand the applications of 3D Printing in Automobile, Aerospace, Bio-medical etc.                                                                                   |                        |                           |   |   |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                            |                        |                           |   |   |      |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                            |                        |                           |   |   |      |
| C101.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply the features of robots and the technology involved in their control.                                                                                                 |                        |                           |   |   | [AP] |
| C101.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply basic engineering knowledge and relevant laws for the design of robotics.                                                                                            |                        |                           |   |   | [AP] |
| C101.3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply the concepts of various configurations, classifications, and parts of end effectors to compare different end effectors, grippers, tools, and sensors used in robots. |                        |                           |   |   | [AP] |
| C101.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply the principles of kinematics, degeneracy, dexterity, and trajectory planning in robotics applications.                                                               |                        |                           |   |   | [AP] |
| C101.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Apply image processing and image analysis techniques using a machine vision system.                                                                                        |                        |                           |   |   | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit –1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | INTRODUCTION AND BASIC PRINCIPLES                                                                                                                                          |                        |                           |   |   | 9    |
| introduction, Generic 3D Printing Process, Benefits, Distinction Between 3D Printing and CNC Machining, Other Related Technologies Development of 3D Printing Technology: Introduction, Computers, Computer-Aided Design Technology, Other Associated Technologies, The Use of Layers, Classification of 3D Printing Processes, Metal Systems, Hybrid Systems, Milestones in 3D Printing Development, 3D Printing around the World.                                                                                                                        |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit –2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3D PRINTING PROCESS CHAIN & PHOTOPOLYMERIZATION PROCESSES                                                                                                                  |                        |                           |   |   | 9    |
| Eight Steps in Additive Manufacture, Variations from One 3D Printing Machine to Another, Metal Systems, Maintenance of Equipment, Materials Handling Issues, Design for 3D PRINTING. Introduction to Photopolymerization Processes: Photopolymerization Materials, Reaction Rates, Vector Scan SL, SL Resin Curing Process, SL Scan Patterns, Vector Scan Micro stereolithography, Mask Projection Photopolymerization Technologies and Processes, Two-Photon SL.                                                                                          |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit –3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | POWDER BED FUSION PROCESSES & EXTRUSION-BASED SYSTEMS                                                                                                                      |                        |                           |   |   | 9    |
| Powder Bed Fusion Processes: Introduction, SLS Process Description, Powder Handling, Approaches to Metal and Ceramic Part Creation, Variants of Powder Bed Fusion Processes, Process Parameters for 3D Printing, Applied Energy Correlations and Scan Patterns, Typical Materials and Applications, Materials – Capabilities and Limitations. Extrusion-Based Systems: Introduction, Basic Principles, Plotting and Path Control, Materials, Limitations of FDM, Bioextrusion, Other Systems                                                               |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit –4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | DESIGN GUIDELINES FOR PROCESS SELECTION & SOFTWARE ISSUES                                                                                                                  |                        |                           |   |   | 9    |
| Design for 3D Printing – Design for Manufacturing and Assembly, Core DFMA for 3D Printing Concepts and Objectives, 3D Printing Unique Capabilities, Exploring Design Freedoms, Design Tools for 3D Printing. Guidelines for Process Selection – Selection Methods for a Part, Challenges of Selection, Preliminary Selection, Production Planning and Control. Software Issues for 3D Printing – Preparation of CAD Models – the STL File, Problems with STL Files, STL File Manipulation, Beyond the STL File, Additional Software to Assist 3D Printing. |                                                                                                                                                                            |                        |                           |   |   |      |
| Unit –5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | MEDICAL APPLICATIONS & FUTURE DIRECTIONS FOR 3D PRINTING                                                                                                                   |                        |                           |   |   | 9    |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Medical Applications for 3D Printing - Use of 3D Printing to Support Medical Applications, Software Support for Medical Applications, Limitations of 3D Printing for Medical Applications, Further Development of Medical 3D Printing Applications. Use of Multiple Materials in 3D Printing - Discrete Multiple Material Processes, Porous Multiple Material Processes, Blended Multiple Material Processes, Embedded Component 3D Printing, Commercial Applications Using Multiple Materials, Future Directions, Business Opportunities and Future Directions |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

|                        |                                                                                                                                            | TotalHours | 45 |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|------------|----|
| <b>Textbooks:</b>      |                                                                                                                                            |            |    |
| 1                      | IanGibson, DavidWRosen, BrentStucker., “AdditiveManufacturingTechnologies: Rapid PrototypingtoDirectDigitalManufacturing”, Springer, 2010. |            |    |
| 2                      | KhannaEditorial, “3DPrintingandDesign”, KhannaPublishingHouse,Delhi.                                                                       |            |    |
| <b>ReferenceBooks:</b> |                                                                                                                                            |            |    |
| 1                      | ChuaCheeKai, LeongKahFai, “RapidPrototyping:Principles&Applications”, WorldScientific,2003.                                                |            |    |
| 2                      | AliK. Kamrani, EmandAbouelNasr, “RapidPrototyping: Theory&Practice”,Springer,2006.                                                         |            |    |
| 3                      | D.T. Pham, S.S. Dimov, RapidManufacturing: TheTechnologiesandApplicationsofRapidprototypingandRapidTooling, Springer 2001.                 |            |    |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                                                    |                       |                   |                         | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand                                                  |                       |                   |                         |            |            |                          |
| Apply                                                       |                       |                   |                         |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS 01 | PS 02 | PS 03 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|
| C101.1      | ✓    | ✓    | ✓    | ✓    |      |      |      |      |      |       |       |       |       | ✓     |       |
| C101.2      | ✓    | ✓    | ✓    | ✓    |      |      |      |      |      |       |       | ✓     |       | ✓     |       |
| C101.3      | ✓    | ✓    | ✓    | ✓    |      |      |      |      |      |       |       | ✓     |       | ✓     |       |
| C101.4      | ✓    | ✓    | ✓    | ✓    |      |      |      |      |      |       |       | ✓     |       | ✓     |       |
| C101.5      | ✓    | ✓    | ✓    | ✓    |      |      |      |      |      |       |       | ✓     |       | ✓     |       |

Prepared by \_\_\_\_\_ Approved by \_\_\_\_\_

| Course Code                                                                                                                                                                                                                                                                                                                                                                                                              | Course Name                                                                                                                               | Category               | Hours/Week                |   |   | C    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                           |                        | L                         | T | P |      |
| 24OE634                                                                                                                                                                                                                                                                                                                                                                                                                  | DIGITAL MANUFACTURING                                                                                                                     | OE                     | 3                         | 0 | 0 | 3    |
| Regulation R24                                                                                                                                                                                                                                                                                                                                                                                                           | Nature of the Course                                                                                                                      | Semester               | Data Book/Codes/Standards |   |   |      |
|                                                                                                                                                                                                                                                                                                                                                                                                                          | THEORY                                                                                                                                    |                        | -----                     |   |   |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                           | Co-requisite Course(s) |                           |   |   |      |
|                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                           |                        |                           |   |   |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                           |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                        | To study the various aspects of digital manufacturing.                                                                                    |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                        | To inculcate the importance of DM in Product Lifecycle Management and Supply                                                              |                        |                           |   |   |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                        | Chain Management.                                                                                                                         |                        |                           |   |   |      |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                        | To formulate of smart manufacturing systems in the digital work environment.                                                              |                        |                           |   |   |      |
| 5                                                                                                                                                                                                                                                                                                                                                                                                                        | To interpret IoT to support the digital manufacturing.                                                                                    |                        |                           |   |   |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                           |                        |                           |   |   |      |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                           |                        |                           |   |   |      |
| C101.1                                                                                                                                                                                                                                                                                                                                                                                                                   | Impart knowledge to use various elements in the digital manufacturing.                                                                    |                        |                           |   |   | [U]  |
| C101.2                                                                                                                                                                                                                                                                                                                                                                                                                   | Differentiate the concepts involved in digital product development life cycle process and supply chain management in digital environment. |                        |                           |   |   | [AP] |
| C101.3                                                                                                                                                                                                                                                                                                                                                                                                                   | Select the proper procedure of validating practical work through digital validation in Factories.                                         |                        |                           |   |   | [AP] |
| C101.4                                                                                                                                                                                                                                                                                                                                                                                                                   | Implementation the concepts of IoT and its role in digital manufacturing.                                                                 |                        |                           |   |   | [AP] |
| C101.5                                                                                                                                                                                                                                                                                                                                                                                                                   | Analyse and optimize various practical manufacturing process through digital twin                                                         |                        |                           |   |   | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                           |                        |                           |   |   |      |
| Unit -1                                                                                                                                                                                                                                                                                                                                                                                                                  | INTRODUCTION                                                                                                                              |                        |                           |   |   | 9    |
| Introduction-Need-Overview of Digital Manufacturing and the Past- Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management-Practical Benefits of Digital Manufacturing-The Future of Digital Manufacturing.                                                                                                                                                                       |                                                                                                                                           |                        |                           |   |   |      |
| Unit -2                                                                                                                                                                                                                                                                                                                                                                                                                  | DIGITAL LIFE CYCLE & SUPPLY CHAIN MANAGEMENT                                                                                              |                        |                           |   |   | 9    |
| Collaborative Product Development, Mapping Requirements to specifications- Part Numbering, Engineering Vaulting, and Product reuse- Engineering Change Management, Bill of Material and Process Consistency- Digital Mockup and Prototyping development- Virtual testing and collateral. Overview of Digital Supply Chain- Scope & Challenges in Digital SC - Effective Digital Transformation - Future Practices in SCM |                                                                                                                                           |                        |                           |   |   |      |
| Unit -3                                                                                                                                                                                                                                                                                                                                                                                                                  | SMART FACTORY                                                                                                                             |                        |                           |   |   | 9    |
| Smart Factory- Level of Smart Factories- Benefits- Technologies used in Smart Factory- Smart Factory into IoT- Key Principles of a Smart Factory - Creating a Smart Factory- Smart Factories and Cyber security                                                                                                                                                                                                          |                                                                                                                                           |                        |                           |   |   |      |
| Unit -4                                                                                                                                                                                                                                                                                                                                                                                                                  | INDUSTRY 4.0                                                                                                                              |                        |                           |   |   | 9    |
| Introduction- Industry 4.0- Internet of Things- Industrial Internet of Things- Framework: Connectivity devices and services - Intelligent networks of manufacturing - Cloud computing- Data analytics- Cyber physical systems- Machine to Machine communication - Case Studies.                                                                                                                                          |                                                                                                                                           |                        |                           |   |   |      |
| Unit -5                                                                                                                                                                                                                                                                                                                                                                                                                  | STUDY OF DIGITAL TWIN                                                                                                                     |                        |                           |   |   | 9    |
| Basic Concepts - Features and Implementation - Digital Twin: Digital Thread and Digital Shadow- Building Blocks- Types - Characteristics of a Good Digital Twin Platform- Benefits, Impact & Challenges- Future of Digital Twins.                                                                                                                                                                                        |                                                                                                                                           |                        |                           |   |   |      |
| Total Hours                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                           |                        |                           |   |   | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                           |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                        | Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.     |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                        | Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2016.                                                      |                        |                           |   |   |      |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                           |                        |                           |   |   |      |
| Reference Books:                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                           |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                        | Lihui Wang and Andrew Yeh Ching Nee, Collaborative Design and Planning for Digital                                                        |                        |                           |   |   |      |

|                        |                                                                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | Manufacturing, Springer-Verlag London Limited, 2009                                                                                            |
| 2                      | Andrew Yeh, Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019              |
| 3                      | Ustundag and Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2017 |
| 4                      | Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.                             |
| <b>Web References:</b> |                                                                                                                                                |
| 1                      | <a href="https://link.springer.com">https://link.springer.com</a>                                                                              |
| 2                      | <a href="https://www.reddit.com">https://www.reddit.com</a>                                                                                    |
| 3                      | <a href="https://link.springer.com">https://link.springer.com</a>                                                                              |

**Assessment based on Continuous and End Semester Examination**

| Bloom's Level            | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|--------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
|                          | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                 |                       |                   |                         | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand               | 4                     | 2                 | 2                       |            |            |                          |
| Apply                    | 2                     | 4                 | 6                       |            |            |                          |
| Analyze                  |                       |                   |                         |            |            |                          |
| Evaluate                 |                       |                   |                         |            |            |                          |
| Create                   |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|
| C101.1      | ✓    | ✓    |      | ✓    | ✓    |      |      |      |      | ✓     |       | ✓     | ✓     | ✓     |       |
| C101.2      | ✓    | ✓    |      | ✓    | ✓    |      |      |      |      | ✓     |       | ✓     | ✓     | ✓     |       |
| C101.3      | ✓    | ✓    |      | ✓    | ✓    |      |      |      |      | ✓     |       | ✓     | ✓     | ✓     |       |
| C101.4      | ✓    | ✓    |      | ✓    | ✓    |      |      |      |      | ✓     |       | ✓     | ✓     | ✓     |       |
| C101.5      | ✓    | ✓    |      | ✓    | ✓    |      |      |      |      | ✓     |       | ✓     | ✓     | ✓     |       |

Prepared by \_\_\_\_\_ Approved by \_\_\_\_\_

| Course Code                                                                                                                                                                                                                                                                                                                                                                 | CourseName                                                                                                              | Category              | Hours/Week               |   |   | C    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|---|------|
|                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                         |                       | L                        | T | P |      |
| 24OE635                                                                                                                                                                                                                                                                                                                                                                     | CompositeMaterials                                                                                                      | PC                    | 3                        | 0 | 0 | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                                  | NatureoftheCourse                                                                                                       | Semester              | DataBook/Codes/Standards |   |   |      |
| R24A                                                                                                                                                                                                                                                                                                                                                                        | THEORY                                                                                                                  |                       | -----                    |   |   |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                         | Co-requisiteCourse(s) |                          |   |   |      |
|                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                         |                       |                          |   |   |      |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                         |                       |                          |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                                                           | To introduce the fundamental concepts, classification, and applications of composite materials.                         |                       |                          |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                                                           | To provide knowledge on different types of reinforcement and matrix materials used in composites.                       |                       |                          |   |   |      |
| 3                                                                                                                                                                                                                                                                                                                                                                           | To impart understanding of various composite fabrication methods and processing techniques.                             |                       |                          |   |   |      |
| 4                                                                                                                                                                                                                                                                                                                                                                           | To develop knowledge of mechanical behavior, testing methods, and failure mechanisms of composites.                     |                       |                          |   |   |      |
| 5                                                                                                                                                                                                                                                                                                                                                                           | To explore advancements and emerging trends in composite materials.                                                     |                       |                          |   |   |      |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                         |                       |                          |   |   |      |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                                                               |                                                                                                                         |                       |                          |   |   |      |
| C101.1                                                                                                                                                                                                                                                                                                                                                                      | Explain the classification, characteristics, and applications of composite materials                                    |                       |                          |   |   | [U]  |
| C101.2                                                                                                                                                                                                                                                                                                                                                                      | Identify and describe types of reinforcement and matrix materials used in composites                                    |                       |                          |   |   | [U]  |
| C101.3                                                                                                                                                                                                                                                                                                                                                                      | Apply suitable composite manufacturing techniques for specific applications                                             |                       |                          |   |   | [AP] |
| C101.4                                                                                                                                                                                                                                                                                                                                                                      | Analyze the mechanical behavior and failure mechanisms in composite materials                                           |                       |                          |   |   | [AP] |
| C101.5                                                                                                                                                                                                                                                                                                                                                                      | Discuss recent trends and developments in advanced composites                                                           |                       |                          |   |   | [U]  |
| CourseContents                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                         |                       |                          |   |   |      |
| Unit –1                                                                                                                                                                                                                                                                                                                                                                     | Introduction:                                                                                                           |                       |                          |   |   | 9    |
| Introduction and overview of composite materials and their need, Enhancement of properties, classification of composites, Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC), Application of composites.                                                                                                                |                                                                                                                         |                       |                          |   |   |      |
| Unit –2                                                                                                                                                                                                                                                                                                                                                                     | Reinforcements Materials:                                                                                               |                       |                          |   |   | 9    |
| Metallic, Polymer, Ceramic and Composite fibres, Whiskers and Particulates, Nano-fillers used in polymer composites, Reinforcement fibres, Woven fabrics and Nonwoven random mats. Types of matrix: Commonly used Matrices (Metal matrix, Polymer matrix, Ceramic matrix, Intermetallic matrix, Carbon-Carbon composites), Basic Requirements in Selection of constituents. |                                                                                                                         |                       |                          |   |   |      |
| Unit –3                                                                                                                                                                                                                                                                                                                                                                     | Production techniques:                                                                                                  |                       |                          |   |   | 9    |
| Processing of cast composites -XD process, Spray processes, In-situ Dispersion Processes, Liquid metal impregnation technique. Hand lay-up processes - Spray up processes, Compression moulding, Reinforced reaction injection moulding, Resin transfer moulding, Pultrusion, Filament winding, Injection moulding.                                                         |                                                                                                                         |                       |                          |   |   |      |
| Unit –4                                                                                                                                                                                                                                                                                                                                                                     | Mechanics of Composite Materials:                                                                                       |                       |                          |   |   | 9    |
| Continuous fibres - iso-stress and iso-strain conditions, discontinuous fibres, Nature of stress vs. strain curves for different composite materials. Mechanical Properties: Mechanical testing of composites - tensile, flexure (3 point and 4 point bend tests), interfacial tests of laminates; Modes of fracture; Toughening mechanisms in composites.                  |                                                                                                                         |                       |                          |   |   |      |
| Unit –5                                                                                                                                                                                                                                                                                                                                                                     | Recent developments in Composites:                                                                                      |                       |                          |   |   | 9    |
| Self healing composites, Molecular composites, Micro and Nanocomposites, Biocomposites, Left handed composites, Stiffer than stiff composites, Carbon / carbon composites (Advantages and limitations of carbon matrix).                                                                                                                                                    |                                                                                                                         |                       |                          |   |   |      |
| TotalHours                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                         |                       |                          |   |   | 45   |
| Textbooks:                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                         |                       |                          |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                                                           | K.K.Chawla, <i>Composite Materials - Science and Engineering</i> , Springer, 3rd Edition, 2012.                         |                       |                          |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                                                           | Gibson, R.F., <i>Principles of Composite Material Mechanics</i> , CRC Press, 4th Edition, 2016.                         |                       |                          |   |   |      |
| ReferenceBooks:                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                         |                       |                          |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                                                           | Mallick, P.K., <i>Fiber-Reinforced Composites: Materials, Manufacturing, and Design</i> , CRC Press, 3rd Edition, 2007. |                       |                          |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                                                           | Mathews F.L., Rawlings R.D., <i>Composite Materials: Engineering and Science</i> , Woodhead Publishing,                 |                       |                          |   |   |      |

|   |                                                                                                         |
|---|---------------------------------------------------------------------------------------------------------|
|   | 1999.                                                                                                   |
| 3 | Agarwal, B. D., Broutman, L. J., Analysis and Performance of Fiber Composites, Wiley, 3rd Edition, 2006 |
| 4 | Sharma S.C., Composite materials, Narosa Publications, 2000.                                            |
| 5 | Mallick, P.K, Composite Materials Technology: Process and Properties, Hanser, New York, 1990.           |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | Continuous Assessment |                   |                         | Assignment | Attendance | End Semester Examination |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) |            |            |                          |
| Remember                                                    |                       |                   |                         | (10 Marks) | (10 Marks) | (60 Marks)               |
| Understand                                                  | 20                    | 20                | 20                      |            |            |                          |
| Apply                                                       | 30                    | 30                | 80                      |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL mark split up may vary based on the nature of the subject.

| COs/<br>POs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|-------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|
| C101.1      | ✓    |      |      |      |      |      | ✓    |      |      |       |       |       |       |       |       |
| C101.2      | ✓    | ✓    |      |      |      |      | ✓    |      |      |       |       |       |       |       |       |
| C101.3      | ✓    | ✓    | ✓    |      | ✓    |      |      |      |      |       |       | ✓     |       |       |       |
| C101.4      | ✓    | ✓    | ✓    | ✓    | ✓    |      |      |      |      |       |       | ✓     |       |       |       |
| C101.5      | ✓    |      |      |      | ✓    |      | ✓    |      |      |       |       | ✓     |       |       |       |

| Course Code                                                                                                                                                                                                                                             | Course Name                                                                                                                            | Category               | Hours/Week                |   |             | C   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|-------------|-----|
|                                                                                                                                                                                                                                                         |                                                                                                                                        |                        | L                         | T | P           |     |
| 24OE637                                                                                                                                                                                                                                                 | ORGANISATIONAL BEHAVIOUR                                                                                                               | OE                     | 3                         | 0 | 0           | 3   |
| Regulation                                                                                                                                                                                                                                              | Nature of the Course                                                                                                                   | Semester               | Data Book/Codes/Standards |   |             |     |
| R24                                                                                                                                                                                                                                                     | THEORY                                                                                                                                 |                        | -----                     |   |             |     |
| Pre-requisite Course(s)                                                                                                                                                                                                                                 |                                                                                                                                        | Co-requisite Course(s) |                           |   |             |     |
| -                                                                                                                                                                                                                                                       |                                                                                                                                        |                        |                           |   |             |     |
| Course Objectives                                                                                                                                                                                                                                       |                                                                                                                                        |                        |                           |   |             |     |
| 1                                                                                                                                                                                                                                                       | To help students to understand the concepts of organizational behavior and basics of personality                                       |                        |                           |   |             |     |
| 2                                                                                                                                                                                                                                                       | To help them recognize the role of individual personality, perception and learning in organizational effectiveness                     |                        |                           |   |             |     |
| 3                                                                                                                                                                                                                                                       | To discuss the learning process and development of attitude                                                                            |                        |                           |   |             |     |
| 4                                                                                                                                                                                                                                                       | To explain group dynamics and skills required for working groups                                                                       |                        |                           |   |             |     |
| 5                                                                                                                                                                                                                                                       | To examine organizational climate and culture                                                                                          |                        |                           |   |             |     |
| Course Outcomes                                                                                                                                                                                                                                         |                                                                                                                                        |                        |                           |   |             |     |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                           |                                                                                                                                        |                        |                           |   |             |     |
| OE637.1                                                                                                                                                                                                                                                 | Comprehend the fundamental concepts in organizational behaviour                                                                        |                        |                           |   |             | [U] |
| OE637.2                                                                                                                                                                                                                                                 | Explain the difference in the individual behaviour                                                                                     |                        |                           |   |             | [U] |
| OE637.3                                                                                                                                                                                                                                                 | Relate motivation, morale and attitude                                                                                                 |                        |                           |   |             | [U] |
| OE637.4                                                                                                                                                                                                                                                 | Demonstrate the significance of working as a group and understand leadership                                                           |                        |                           |   |             | [U] |
| OE637.5                                                                                                                                                                                                                                                 | Outline the importance of organizational climate and culture                                                                           |                        |                           |   |             | [U] |
| Course Contents                                                                                                                                                                                                                                         |                                                                                                                                        |                        |                           |   |             |     |
| Unit-1                                                                                                                                                                                                                                                  | INTRODUCTION TO MANAGEMENT                                                                                                             |                        |                           |   |             | 9   |
| Organizational Behaviour: Definition-Importance and Scope of Organizational Behaviour, Factors influencing OB-Contributing disciplines to OB. Individual Differences-Intelligence tests-Measurement of Intelligence.                                    |                                                                                                                                        |                        |                           |   |             |     |
| Unit-2                                                                                                                                                                                                                                                  | PERSONALTY, PERCEPTION AND LEARNING                                                                                                    |                        |                           |   |             | 9   |
| Personality: Meaning, Types, Determinants of Personality, Personality Theory (Psychoanalytic Theory), Perception-Meaning-Process-Factors affecting Perception. Learning-Meaning-Concepts-Factors affecting learning,                                    |                                                                                                                                        |                        |                           |   |             |     |
| Unit-3                                                                                                                                                                                                                                                  |                                                                                                                                        |                        |                           |   |             | 9   |
| Motivation-Meaning-Theories (Maslow's, Herzberg's, McGregors X and Y theory, Morale-meaning-Importance. Attitude: Meaning & Components, Work attitude,                                                                                                  |                                                                                                                                        |                        |                           |   |             |     |
| Unit-4                                                                                                                                                                                                                                                  | GROUP DYNAMICS AND LEADERSHIP                                                                                                          |                        |                           |   |             | 9   |
| Group dynamics: Group-Meaning-types, group cohesiveness-Group Norms-Group decision making. Team-Meaning, Types, Difference between group and team. Leadership-Meaning, Characteristics of a Successful Leader, Leadership Styles-Managerial Grid Theory |                                                                                                                                        |                        |                           |   |             |     |
| Unit-5                                                                                                                                                                                                                                                  | ORGANISATIONAL DYNAMICS                                                                                                                |                        |                           |   |             | 9   |
| Organizational climate- meaning, components and factors affecting organizational climate. Organizational Culture-Types, creating and sustaining culture, managing cultural diversity.                                                                   |                                                                                                                                        |                        |                           |   |             |     |
|                                                                                                                                                                                                                                                         |                                                                                                                                        |                        |                           |   | Total Hours | 45  |
| Textbooks:                                                                                                                                                                                                                                              |                                                                                                                                        |                        |                           |   |             |     |
| 1                                                                                                                                                                                                                                                       | Prasad.L.M - "Organizational Behaviour, Sultan Chand & Son, New Delhi, 2024                                                            |                        |                           |   |             |     |
| 2                                                                                                                                                                                                                                                       | Stephen P. Robbins, Timothy A judge & Neharika Vohra- "Organizational Behaviour", 8 <sup>th</sup> Edition, Pearson Education Ltd, 2022 |                        |                           |   |             |     |
| Reference Books:                                                                                                                                                                                                                                        |                                                                                                                                        |                        |                           |   |             |     |
| 1                                                                                                                                                                                                                                                       | Aswathappa. K, "Organizational Behavior", Himalaya Publishing House, 2024                                                              |                        |                           |   |             |     |

|   |                                                                                                |
|---|------------------------------------------------------------------------------------------------|
| 2 | Fred Luthans, "Organisational Behaviour", McGraw Hill Book Co., 14 <sup>th</sup> edition, 2020 |
|---|------------------------------------------------------------------------------------------------|

**Assessment based on Continuous and End Semester Examination**

| Bloom's Level            | CONTINUOUS ASSESSMENT |                   |                         | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|--------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
|                          | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                 |                       |                   |                         |            |            |                          |
| Understand               | 100%                  | 100%              | 100%                    |            |            |                          |
| Apply                    |                       |                   |                         |            |            |                          |
| Analyze                  |                       |                   |                         |            |            |                          |
| Evaluate                 |                       |                   |                         |            |            |                          |
| Create                   |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b> | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P010 | P011 | PS01 | PS02 | PS03 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| OE637.1     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |
| OE637.2     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |
| OE637.3     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |
| OE637.4     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |
| OE637.5     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |

| Course Code                                                                                                                                                                                                                                                                                                                                                          | CourseName                                                                                                                                                        | Category              | Hours/Week               |   |   | C    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|---|---|------|
|                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                   |                       | L                        | T | P |      |
| 24OE638                                                                                                                                                                                                                                                                                                                                                              | Total Quality Management                                                                                                                                          | OE                    | 3                        | 0 | 0 | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                                           | NatureoftheCourse                                                                                                                                                 | Semester              | DataBook/Codes/Standards |   |   |      |
| R24                                                                                                                                                                                                                                                                                                                                                                  | THEORY                                                                                                                                                            | -                     | -----                    |   |   |      |
| Pre-requisiteCourse(s)                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                   | Co-requisiteCourse(s) |                          |   |   |      |
| -                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                   |                       |                          |   |   |      |
| CourseObjectives                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                   |                       |                          |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                                                    | To introduce the fundamental concepts, principles, and evolution of Total Quality Management (TQM) and their significance in achieving organizational excellence. |                       |                          |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                                                    | To develop an understanding of TQM principles such as leadership, employee involvement, continuous improvement, and supplier partnership for quality enhancement. |                       |                          |   |   |      |
| 3                                                                                                                                                                                                                                                                                                                                                                    | To familiarize students with quality management tools and techniques used for problem-solving and process improvement in manufacturing and services sectors.      |                       |                          |   |   |      |
| 4                                                                                                                                                                                                                                                                                                                                                                    | To provide knowledge of advanced quality tools, process capability analysis, and quality improvement methodologies for organizational performance.                |                       |                          |   |   |      |
| 5                                                                                                                                                                                                                                                                                                                                                                    | To impart an understanding of quality management systems and international standards for implementing effective quality practices in organizations.               |                       |                          |   |   |      |
| CourseOutcomes                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                   |                       |                          |   |   |      |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                   |                       |                          |   |   |      |
| OE638.1                                                                                                                                                                                                                                                                                                                                                              | Explain the concepts, principles, frameworks, and importance of Total Quality Management, including customer focus and cost of quality.                           |                       |                          |   |   | [U]  |
| OE638.2                                                                                                                                                                                                                                                                                                                                                              | Apply TQM principles such as leadership, employee involvement, continuous improvement, and supplier partnership to enhance organizational quality practices.      |                       |                          |   |   | [AP] |
| OE638.3                                                                                                                                                                                                                                                                                                                                                              | Apply quality management tools and techniques, including the seven QC tools, Six Sigma, benchmarking, and FMEA, to solve quality-related problems.                |                       |                          |   |   | [AP] |
| OE638.4                                                                                                                                                                                                                                                                                                                                                              | Apply control charts, process capability analysis, QFD, Taguchi methods, and TPM concepts to improve process performance and product quality.                     |                       |                          |   |   | [AP] |
| OE638.5                                                                                                                                                                                                                                                                                                                                                              | Explain the requirements and implementation of ISO 9000, ISO 9001, ISO 14000, quality auditing, and quality systems in manufacturing and services sectors.        |                       |                          |   |   | [U]  |
| CourseContents                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                   |                       |                          |   |   |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                                               | INTRODUCTION                                                                                                                                                      |                       |                          |   |   | 9    |
| Introduction - Need for quality-Evolution of quality-Definitions of quality-Dimensions of product and service quality -Basic concepts of TQM - TQM Framework-Contributions of Deming, Juran and Crosby-Barrier to TQM-Quality statements-Customer focus-Customer orientation, Customer satisfaction, Customer complaints, and Customer retention - Costs of quality. |                                                                                                                                                                   |                       |                          |   |   |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                                               | TQM PRINCIPLES                                                                                                                                                    |                       |                          |   |   | 9    |
| Leadership-Strategic quality planning, Quality Councils-Employee involvement-Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal-Continuous process improvement-PDCA cycle, 5S, Kaizen-Supplier partnership-Partnering, Supplier selection, Supplier Rating.                                                   |                                                                                                                                                                   |                       |                          |   |   |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                                               | TQM TOOLS & TECHNIQUES I                                                                                                                                          |                       |                          |   |   | 9    |
| These seven traditional tools of quality-New management tools-Six sigma: Concepts, Methodology, application to manufacturing, services sector including IT-Benchmarking-Reason to benchmark, Bench marking process - FMEA - Stages, Types.                                                                                                                           |                                                                                                                                                                   |                       |                          |   |   |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                                               | TQM TOOLS & TECHNIQUES II                                                                                                                                         |                       |                          |   |   | 9    |
| Control Charts-Process Capability-Concepts of Six Sigma-Quality Function Development (QFD)- Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.                                                                                                                                                                                |                                                                                                                                                                   |                       |                          |   |   |      |
| Unit-5                                                                                                                                                                                                                                                                                                                                                               | QUALITY SYSTEMS                                                                                                                                                   |                       |                          |   |   | 9    |



|                                                                                                                                                                                                         |                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Need for ISO 9000-ISO 9001-2008 Quality System-Elements, Documentation, Quality Auditing-QS 9000-ISO 14000-Concepts, Requirements and Benefits-TQM Implementation in manufacturing and service sectors. |                                                                                                                                                                                                                                           |
| <b>Total Hours</b>                                                                                                                                                                                      |                                                                                                                                                                                                                                           |
| <b>45</b>                                                                                                                                                                                               |                                                                                                                                                                                                                                           |
| <b>Textbooks:</b>                                                                                                                                                                                       |                                                                                                                                                                                                                                           |
| 1                                                                                                                                                                                                       | Dale H. Besterfield, Carol B. Michna, Glen H. Besterfield, Mary B. Sacre, Hemant Urdhwareeshe and Rashmi Urdhwareeshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013. |
| 2                                                                                                                                                                                                       | Joel E. Ross, "Total Quality Management - Text and Cases", Routledge., 2017.                                                                                                                                                              |
| <b>Reference Books:</b>                                                                                                                                                                                 |                                                                                                                                                                                                                                           |
| 1                                                                                                                                                                                                       | Kiran D.R., "Total Quality Management: Key concepts and case studies", Butterworth-Heinemann Ltd, 2016.                                                                                                                                   |
| 2                                                                                                                                                                                                       | Suganthi, L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.                                                                                                                                          |
| <b>Web References:</b>                                                                                                                                                                                  |                                                                                                                                                                                                                                           |
| 1                                                                                                                                                                                                       | <a href="https://www.youtube.com/playlist?list=PL2H1Li34F7gRnoyJer96C5R4dG48G6e0">https://www.youtube.com/playlist?list=PL2H1Li34F7gRnoyJer96C5R4dG48G6e0</a>                                                                             |
| 2                                                                                                                                                                                                       | <a href="https://www.youtube.com/watch?v=OSz7MvkPhFI">https://www.youtube.com/watch?v=OSz7MvkPhFI</a>                                                                                                                                     |
| 3                                                                                                                                                                                                       | <a href="https://www.youtube.com/playlist?list=PL8fPvgxF8y0XY6AKVJMq9V_fbT0clL6N_">https://www.youtube.com/playlist?list=PL8fPvgxF8y0XY6AKVJMq9V_fbT0clL6N_</a>                                                                           |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | CONTINUOUS ASSESSMENT |                   |                         | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                   |                         |            |            |                          |
| Understand                                                  | 80%                   |                   | 80%                     |            |            |                          |
| Apply                                                       | 20%                   | 100%              | 20%                     |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PS01 | PS02 | PS03 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| OE638.1     | -   | 2   | 2   | -   | -   | -   | 3   | -   | 2   | -    | -    | -    | -    | -    |
| OE638.2     | -   | -   | 2   | 1   | -   | 2   | 2   | -   | 2   | -    | -    | -    | -    | -    |
| OE638.3     | -   | 3   | 1   | 1   | 2   | -   | -   | -   | 3   | -    | -    | -    | -    | 2    |
| OE638.4     | -   | -   | 1   | 1   | -   | 2   | -   | -   | 1   | -    | -    | -    | -    | 2    |
| OE638.5     | -   | -   | 2   | -   | 2   | -   | -   | -   | -   | -    | -    | 1    | -    | -    |

| Course Code                                                                                                                                                                                                                                                                                                                                          | Course Name                                                                                                                                                                                                             | Category               | Hours/Week                |   |   | C    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|
|                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                         |                        | L                         | T | P |      |
| 24OE639                                                                                                                                                                                                                                                                                                                                              | Intellectual Property Rights                                                                                                                                                                                            |                        | 3                         | 0 | 0 | 3    |
| Regulation                                                                                                                                                                                                                                                                                                                                           | Nature of the Course                                                                                                                                                                                                    | Semester               | Data Book/Codes/Standards |   |   |      |
| R24                                                                                                                                                                                                                                                                                                                                                  | THEORY                                                                                                                                                                                                                  | -                      | -----                     |   |   |      |
| Pre-requisite Course(s)                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                         | Co-requisite Course(s) |                           |   |   |      |
| -                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                         |                        |                           |   |   |      |
| Course Objectives                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                         |                        |                           |   |   |      |
| 1                                                                                                                                                                                                                                                                                                                                                    | To introduce the fundamental concepts, types, significance, and evolution of Intellectual Property Rights in India and globally.                                                                                        |                        |                           |   |   |      |
| 2                                                                                                                                                                                                                                                                                                                                                    | To familiarize students with the procedures and practical aspects involved in registering various forms of intellectual property in India and abroad.                                                                   |                        |                           |   |   |      |
| 3                                                                                                                                                                                                                                                                                                                                                    | To provide knowledge of international treaties and national legislations governing Intellectual Property Rights.                                                                                                        |                        |                           |   |   |      |
| 4                                                                                                                                                                                                                                                                                                                                                    | To develop an understanding of the protection of digital innovations and the relationship between IP laws, cyber laws, and unfair competition.                                                                          |                        |                           |   |   |      |
| 5                                                                                                                                                                                                                                                                                                                                                    | To impart knowledge on infringement issues, enforcement mechanisms, and emerging challenges in Intellectual Property Rights.                                                                                            |                        |                           |   |   |      |
| Course Outcomes                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                         |                        |                           |   |   |      |
| Upon completion of the course, students shall have ability to                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                         |                        |                           |   |   |      |
| OE639.1                                                                                                                                                                                                                                                                                                                                              | Explain the fundamental concepts, types, significance, and need for Intellectual Property Rights, including patents, copyrights, geographical indications, TRIPS, and WIPO.                                             |                        |                           |   |   | [U]  |
| OE639.2                                                                                                                                                                                                                                                                                                                                              | Describe the procedures and practical aspects involved in the registration of copyrights, trademarks, patents, geographical indications, trade secrets, and industrial designs in India and abroad.                     |                        |                           |   |   | [U]  |
| OE639.3                                                                                                                                                                                                                                                                                                                                              | Summarize the key provisions of international treaties and national legislations related to Intellectual Property Rights, including TRIPS, PCT, Patent Act, Design Act, Trademark Act, and Geographical Indication Act. |                        |                           |   |   | [U]  |
| OE639.4                                                                                                                                                                                                                                                                                                                                              | Apply Intellectual Property and cyber law principles to analyze the protection of digital innovations, digital content, and issues related to unfair competition through case studies.                                  |                        |                           |   |   | [AP] |
| OE639.5                                                                                                                                                                                                                                                                                                                                              | Apply appropriate legal provisions and enforcement measures to address Intellectual Property Rights infringement and emerging issues using relevant case studies.                                                       |                        |                           |   |   | [AP] |
| Course Contents                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                         |                        |                           |   |   |      |
| Unit-1                                                                                                                                                                                                                                                                                                                                               | INTRODUCTION TO IPR                                                                                                                                                                                                     |                        |                           |   |   | 9    |
| Introduction to IPRs, Basic concepts and need for Intellectual Property – Patents, copyrights, geographical indications. IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO – TRIPS, Nature of Intellectual Property, Industrial Property, technological research, inventions and innovations – Important examples of IPR. |                                                                                                                                                                                                                         |                        |                           |   |   |      |
| Unit-2                                                                                                                                                                                                                                                                                                                                               | REGISTRATION OF IPRs                                                                                                                                                                                                    |                        |                           |   |   | 9    |
| Meaning and practical aspects of registration of copyrights, trademarks, patents, geographical indications, trade secrets and industrial design registration in India and abroad.                                                                                                                                                                    |                                                                                                                                                                                                                         |                        |                           |   |   |      |
| Unit-3                                                                                                                                                                                                                                                                                                                                               | AGREEMENTS AND LEGISLATIONS                                                                                                                                                                                             |                        |                           |   |   | 9    |
| International treaties and conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademarks Act, Geographical Indication Act.                                                                                                                                                                  |                                                                                                                                                                                                                         |                        |                           |   |   |      |
| Unit-4                                                                                                                                                                                                                                                                                                                                               | DIGITAL PRODUCTS AND LAW                                                                                                                                                                                                |                        |                           |   |   | 9    |

Digital innovations and developments as knowledge assets – IP laws, cyber law and digital content protection – unfair competition – meaning and relationship between unfair competition and IP laws – case studies.

|                                                                              |                                                                                                       |    |
|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|----|
| Unit-5                                                                       | ENFORCEMENT OF IP RS                                                                                  | 9  |
| Infringement of IP Rs, enforcement measures, emerging issues – case studies. |                                                                                                       |    |
| Total Hours                                                                  |                                                                                                       | 45 |
| Textbooks:                                                                   |                                                                                                       |    |
| 1                                                                            | Dr. G.B.Reddy, Intellectual Property Rights and The Law, Gogia Law Agency, 2020                       |    |
| 2                                                                            | B.L. Wadehra, Law Relating to Intellectual Property, Universal Law Publishing Co., 2011               |    |
| Reference Books:                                                             |                                                                                                       |    |
| 1                                                                            | P. Narayanan, Intellectual Property Law, Eastern Law House, 2023                                      |    |
| 2                                                                            | Dr.S.R. Myneni, Law of Intellectual Property, Asian Law House, 2012.                                  |    |
| Web References:                                                              |                                                                                                       |    |
| 1                                                                            | <a href="https://www.youtube.com/watch?v=ILXGjaCkM6Y">https://www.youtube.com/watch?v=ILXGjaCkM6Y</a> |    |
| 2                                                                            | <a href="https://www.youtube.com/watch?v=pqRqJ3e4PUE">https://www.youtube.com/watch?v=pqRqJ3e4PUE</a> |    |
| 3                                                                            | <a href="https://www.youtube.com/watch?v=Oj_Vwml-Q18">https://www.youtube.com/watch?v=Oj_Vwml-Q18</a> |    |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | CONTINUOUS ASSESSMENT |                   |                         | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                   |                         |            |            |                          |
| Understand                                                  | 100%                  | 100%              |                         |            |            |                          |
| Apply                                                       |                       |                   | 100%                    |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PS01 | PS02 | PS03 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| OE639.1     | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | -    | 3    | -    | -    | -    |
| OE639.2     | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | -    | 3    | -    | -    | -    |
| OE639.3     | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | -    | 3    | -    | -    | -    |
| OE639.4     | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | -    | 3    | -    | -    | -    |
| OE639.5     | -   | -   | -   | -   | -   | -   | 3   | 3   | -   | -    | 3    | -    | -    | -    |

| Course Code                                                                                                                                                                                                    | Course Name                                                                                                                                                  | Category               | Hours/Week                |   |   | C    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------------------|---|---|------|
|                                                                                                                                                                                                                |                                                                                                                                                              |                        | L                         | T | P |      |
| 24OE640                                                                                                                                                                                                        | EMOTIONAL INTELLIGENCE                                                                                                                                       | OE                     | 3                         | 0 | 0 | 3    |
| Regulation                                                                                                                                                                                                     | Nature of the Course                                                                                                                                         | Semester               | Data Book/Codes/Standards |   |   |      |
| R24                                                                                                                                                                                                            | THEORY                                                                                                                                                       |                        | -----                     |   |   |      |
| Pre-requisite Course(s)                                                                                                                                                                                        |                                                                                                                                                              | Co-requisite Course(s) |                           |   |   |      |
| -                                                                                                                                                                                                              |                                                                                                                                                              |                        |                           |   |   |      |
| Course Objectives                                                                                                                                                                                              |                                                                                                                                                              |                        |                           |   |   |      |
| 1                                                                                                                                                                                                              | To help students gain basic understanding of Emotions                                                                                                        |                        |                           |   |   |      |
| 2                                                                                                                                                                                                              | To provide them with knowledge regarding concepts and models of emotional Intelligence (EI)                                                                  |                        |                           |   |   |      |
| 3                                                                                                                                                                                                              | To enable them to recognize and regulate their emotions                                                                                                      |                        |                           |   |   |      |
| 4                                                                                                                                                                                                              | To help students manage relationship in a positive manner.                                                                                                   |                        |                           |   |   |      |
| 5                                                                                                                                                                                                              | To infer ways to measure and develop strategies for acquiring EQ                                                                                             |                        |                           |   |   |      |
| Course Outcomes                                                                                                                                                                                                |                                                                                                                                                              |                        |                           |   |   |      |
| Upon completion of the course, students shall have ability to                                                                                                                                                  |                                                                                                                                                              |                        |                           |   |   |      |
| OE640.1                                                                                                                                                                                                        | Comprehend the basic concepts of management and evolution in management.                                                                                     |                        |                           |   |   | [U]  |
| OE640.2                                                                                                                                                                                                        | Demonstrate the roles and skills in planning and decision making for the business.                                                                           |                        |                           |   |   | [U]  |
| OE640.3                                                                                                                                                                                                        | Discover personal competencies and manage emotions                                                                                                           |                        |                           |   |   | [U]  |
| OE640.4                                                                                                                                                                                                        | Gain insight into positive relationship through EI                                                                                                           |                        |                           |   |   | [U]  |
| OE640.5                                                                                                                                                                                                        | Identify ways to improve emotional Intelligence                                                                                                              |                        |                           |   |   | [AP] |
| Course Contents                                                                                                                                                                                                |                                                                                                                                                              |                        |                           |   |   |      |
| Unit-1                                                                                                                                                                                                         | INTRODUCTION TO THE CONCEPT OF EMOTION                                                                                                                       |                        |                           |   |   | 9    |
| Emotion- Meaning, characteristics of emotion, components of emotion- cognitive component, physiological component, Behavioural component, Types of emotions,                                                   |                                                                                                                                                              |                        |                           |   |   |      |
| Unit-2                                                                                                                                                                                                         | FUNDAMENTALS OF EMOTIONAL INTELLIGENCE                                                                                                                       |                        |                           |   |   | 9    |
| Nature and Significance, Models of emotional intelligence: Ability, Trait and Mixed, Building blocks of emotional intelligence: self-awareness, self-management, social awareness, and relationship management |                                                                                                                                                              |                        |                           |   |   |      |
| Unit-3                                                                                                                                                                                                         | PERSONAL COMPETENCE                                                                                                                                          |                        |                           |   |   | 9    |
| Self-Awareness: Observing and recognizing one's own feelings, Knowing one's strengths and areas of development. Self-Management: Managing emotions, anxiety, fear, and anger.                                  |                                                                                                                                                              |                        |                           |   |   |      |
| Unit-4                                                                                                                                                                                                         | SOCIAL COMPETENCE                                                                                                                                            |                        |                           |   |   | 9    |
| Social Awareness: Others' Perspectives, Empathy and Compassion, Relationship Management: Effective communication, Collaboration, Teamwork, and Conflict management                                             |                                                                                                                                                              |                        |                           |   |   |      |
| Unit-5                                                                                                                                                                                                         | EMOTIONAL INTELLIGENCE: MEASUREMENT AND DEVELOPMENT                                                                                                          |                        |                           |   |   | 9    |
| Measures of emotional intelligence, Strategies to enhance emotional intelligence                                                                                                                               |                                                                                                                                                              |                        |                           |   |   |      |
| Total Hours                                                                                                                                                                                                    |                                                                                                                                                              |                        |                           |   |   | 45   |
| Textbooks:                                                                                                                                                                                                     |                                                                                                                                                              |                        |                           |   |   |      |
| 1                                                                                                                                                                                                              | Daniel Goleman, Emotional Intelligence: Why it Matters more than IQ, Bloomsbury India, 2021                                                                  |                        |                           |   |   |      |
| 2                                                                                                                                                                                                              | Travis Bradberry, Jean Greaves, Emotional Intelligence 2.0, Talentsmart, 2009                                                                                |                        |                           |   |   |      |
| Reference Books:                                                                                                                                                                                               |                                                                                                                                                              |                        |                           |   |   |      |
| 1                                                                                                                                                                                                              | Dr. Pratik P Surana, Mastering Emotional Intelligence: Making Emotions Work "For" you and not "Against" you, Notion Press, 2021                              |                        |                           |   |   |      |
| 2                                                                                                                                                                                                              | Ryan James, Emotional Intelligence: The Definitive Guide to Understanding Your Emotions, How to Improve Your EQ and Your Relationships, Kindle Edition, 2016 |                        |                           |   |   |      |

| Assessment based on Continuous and End Semester Examination |                       |                   |                         |            |            |                          |
|-------------------------------------------------------------|-----------------------|-------------------|-------------------------|------------|------------|--------------------------|
| Bloom's Level                                               | CONTINUOUS ASSESSMENT |                   |                         | ASSIGNMENT | ATTENDANCE | END SEMESTER EXAMINATION |
|                                                             | CIA1<br>(6 Marks)     | CIA2<br>(6 Marks) | Model Exam<br>(8 Marks) | (10 Marks) | (10 Marks) | (60 Marks)               |
| Remember                                                    |                       |                   |                         |            |            |                          |
| Understand                                                  | 100%                  | 100%              | 80%                     |            |            |                          |
| Apply                                                       |                       |                   | 20%                     |            |            |                          |
| Analyze                                                     |                       |                   |                         |            |            |                          |
| Evaluate                                                    |                       |                   |                         |            |            |                          |
| Create                                                      |                       |                   |                         |            |            |                          |
| <b>Total (100 Marks)</b>                                    | <b>6</b>              | <b>6</b>          | <b>8</b>                | <b>10</b>  | <b>10</b>  | <b>60</b>                |

- CIA1, CIA 2 and Model Exam will be conducted for 50, 50 and 100 marks. It shall be subsequently converted to 6, 6 and 8 marks respectively.
- The Assignment marks will be computed based on Assignment I, Assignment II and Assignment III marks converted to 10 Marks.
- BTL marks split up may vary based on the nature of the subject.

| COs/<br>POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PS01 | PS02 | PS03 |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| OE640.1     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |
| OE640.2     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |
| OE640.3     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |
| OE640.4     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |
| OE640.5     | -   | -   | -   | -   | -   | -   | -   | 3   | 3   | -    | 3    | -    | -    | -    |

| Course Code                                                   | Course Name                                                                                                              | Semester | Category | Hours/Week |   |   | C    |
|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|----------|----------|------------|---|---|------|
|                                                               |                                                                                                                          |          |          | L          | T | P |      |
| 24OE641                                                       | Algebra and Number Theory                                                                                                |          | OE       | 3          | 0 | 0 | 3    |
| <b>Course Outcomes(s)</b>                                     |                                                                                                                          |          |          |            |   |   |      |
| Upon completion of the course, students shall have ability to |                                                                                                                          |          |          |            |   |   | RBT  |
| C01                                                           | Apply algebraic structures and mappings to solve problems related to groups and rings.                                   |          |          |            |   |   | [AP] |
| C02                                                           | Utilize properties of finite fields to analyze and factor expressions within polynomial systems.                         |          |          |            |   |   | [AP] |
| C03                                                           | Implement number-theoretic techniques from divisibility and decomposition to perform structured arithmetic computations. |          |          |            |   |   | [AP] |
| C04                                                           | Solve modular equations and systems using methods from Diophantine analysis and congruences.                             |          |          |            |   |   | [AP] |
| C05                                                           | Apply classical results and arithmetic functions to evaluate and reason about numerical properties.                      |          |          |            |   |   | [AP] |

| CourseContent                                                                                                                                                                         |                                                                                                                                                                                                                                                                     |                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Unit-I                                                                                                                                                                                | GROUPSANDRINGS                                                                                                                                                                                                                                                      | 09             |
| Groups:Definition- Properties- Homomorphism-Isomorphism-Cyclicgroups-Cosets- Lagrange'stheorem.<br>Rings:Definition - Subrings-Integraldomain-Field -Integermodulon-Ringhomomorphism. |                                                                                                                                                                                                                                                                     |                |
| Unit-II                                                                                                                                                                               | FINITEFIELDSANDPOLYNOMIALS                                                                                                                                                                                                                                          | 09             |
| Rings -Polynomialrings -Irreduciblepolynomialsover finite fields-Factorizationofpolynomialsoverfinitefields.                                                                          |                                                                                                                                                                                                                                                                     |                |
| Unit-III                                                                                                                                                                              | DIVISIBILITYTHEORYANDCANONICALDECOMPOSITIONS                                                                                                                                                                                                                        | 09             |
| Divisionalgorithm-Base-brepresentations - Numberpatterns - Primeandcompositenumbers - GCD - Euclideanalgorithm -Fundamental theorem ofarithmetic -LCM.                                |                                                                                                                                                                                                                                                                     |                |
| Unit-IV                                                                                                                                                                               | DIOPHANTINEEQUATIONSANDCONGRUENCES                                                                                                                                                                                                                                  | 09             |
| LinearDiophantineequations-Congruence's-LinearCongruence's-Applications:Divisibilitytests-Modularexponentiation -Chinese remainder theorem - 2x2linearsystems                         |                                                                                                                                                                                                                                                                     |                |
| Unit - V                                                                                                                                                                              | CLASSICALTHEOREMSANDMULTIPLICATIVEFUNCTIONS                                                                                                                                                                                                                         | 09             |
| Wilson'stheorem -Fermat'sLittle theorem -Euler's theorem -Euler'sPhi functions -Tauand Sigmafunctions.                                                                                |                                                                                                                                                                                                                                                                     |                |
|                                                                                                                                                                                       |                                                                                                                                                                                                                                                                     | TOTAL: 45Hours |
| LearningResources                                                                                                                                                                     |                                                                                                                                                                                                                                                                     |                |
| Textbooks                                                                                                                                                                             |                                                                                                                                                                                                                                                                     |                |
| 1                                                                                                                                                                                     | R.P.GrimaldiandB.V.Ramana, <i>DiscreteandCombinatorialMathematics:AnAppliedIntroduction</i> , 5thed. NewDelhi, India:PearsonEducation, 2019.                                                                                                                        |                |
| 2                                                                                                                                                                                     | T.Koshy, <i>ElementaryNumberTheorywithApplications</i> , 2nded. Burlington, MA, USA: AcademicPress, 2007.                                                                                                                                                           |                |
| Reference Books                                                                                                                                                                       |                                                                                                                                                                                                                                                                     |                |
| 1                                                                                                                                                                                     | S. LingandC.Xing, <i>CodingTheory:AFirstCourse</i> , 1sted. Cambridge, U.K.: CambridgeUniversity Press, 2004.                                                                                                                                                       |                |
| 2                                                                                                                                                                                     | I.Niven, H.S.Zuckerman, andH.L.Montgomery, <i>AnIntroductiontotheTheoryofNumbers</i> , 5thed. Singapore: JohnWileyandSons, 2004.                                                                                                                                    |                |
| 3                                                                                                                                                                                     | R.LidlandG.Pilz, <i>AppliedAbstractAlgebra</i> , 2nded. NewDelhi, India: Springer-Verlag, 2006.                                                                                                                                                                     |                |
| Web References                                                                                                                                                                        |                                                                                                                                                                                                                                                                     |                |
| 1                                                                                                                                                                                     | <a href="https://archive.nptel.ac.in/courses/111/106/111106113/">https://archive.nptel.ac.in/courses/111/106/111106113/</a>                                                                                                                                         |                |
| 2                                                                                                                                                                                     | <a href="https://nptel.ac.in/courses/106/106/106106094/">https://nptel.ac.in/courses/106/106/106106094/</a>                                                                                                                                                         |                |
| 3                                                                                                                                                                                     | <a href="https://nptel.ac.in/courses/106/106/106106183/">https://nptel.ac.in/courses/106/106/106106183/</a>                                                                                                                                                         |                |
| 4                                                                                                                                                                                     | <a href="https://nptel.ac.in/courses/106/104/106104137/">https://nptel.ac.in/courses/106/104/106104137/</a>                                                                                                                                                         |                |
| 5                                                                                                                                                                                     | <a href="https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2005/">https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2005/</a> |                |

| Course Code                                                   | Course Name                                                                               | Semester | Category | Hours/Week |   |   | C    |
|---------------------------------------------------------------|-------------------------------------------------------------------------------------------|----------|----------|------------|---|---|------|
|                                                               |                                                                                           |          |          | L          | T | P |      |
| 24OE642                                                       | Linear Algebra                                                                            |          | OE       | 3          | 0 | 0 | 3    |
| <b>Course Outcomes(s)</b>                                     |                                                                                           |          |          |            |   |   |      |
| Upon completion of the course, students shall have ability to |                                                                                           |          |          |            |   |   | RBT  |
| C01                                                           | Test the consistency and solve system of linear equations.                                |          |          |            |   |   | [AP] |
| C02                                                           | Find the basis and dimension of vector space.                                             |          |          |            |   |   | [AP] |
| C03                                                           | Obtain the matrix of linear transformation and its eigenvalues and eigenvectors           |          |          |            |   |   | [AP] |
| C04                                                           | Find orthonormal basis of inner product space and find least square approximation.        |          |          |            |   |   | [AP] |
| C05                                                           | Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition. |          |          |            |   |   | [AP] |

| CourseContent                                                                                                                                                                                    |                                                                                                                           |                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|----------------|
| Unit-I                                                                                                                                                                                           | MATRICESANDSYSTEMOFFLINEAREQUATIONS                                                                                       | 09             |
| Matrices-Rowechelonform-Rank-Systemoflinearequations-Consistency-Gausseliminationmethod-Gauss Jordanmethod.                                                                                      |                                                                                                                           |                |
| Unit-II                                                                                                                                                                                          | VECTORSPACES                                                                                                              | 09             |
| VectorspacesoverRealandComplexfields-Subspace-Linear space -Linearindependenceanddependence - Basisand dimension.                                                                                |                                                                                                                           |                |
| Unit-III                                                                                                                                                                                         | LINEARTRANSFORMATION                                                                                                      | 09             |
| Lineartransformation - Rankspaceandnullspace -Rankandnullity -Dimensiontheorem- Matrixrepresentationoflinear transformation - Eigenvaluesandeigenvectorsoflineartransformation- Diagonalization. |                                                                                                                           |                |
| Unit-IV                                                                                                                                                                                          | INNERPRODUCTSPACES                                                                                                        | 09             |
| Innerproductandnorms- Properties-Orthogonal,Orthonormalvectors-GramSchmidtorthonormalizationprocess - Least squareapproximation.                                                                 |                                                                                                                           |                |
| Unit - V                                                                                                                                                                                         | EIGENVALUEPROBLEMSANDMATRIXDECOMPOSITION                                                                                  | 09             |
| EigenvalueProblems: Powermethod, Jacobirotationmethod - Singularvaluedecomposition - QR decomposition.                                                                                           |                                                                                                                           |                |
|                                                                                                                                                                                                  |                                                                                                                           | TOTAL: 45Hours |
| LearningResources                                                                                                                                                                                |                                                                                                                           |                |
| Textbooks                                                                                                                                                                                        |                                                                                                                           |                |
| 1                                                                                                                                                                                                | J.D.FairesandR.L.Burden, <i>NumericalMethods</i> , 4thed.Boston,MA,USA:CengageLearning, 2012.                             |                |
| 2                                                                                                                                                                                                | S. H. Friedberg,A.J.Insel,andL.E.Spence,LinearAlgebra,5thed.NewDelhi,India:PearsonEducation, 2019.                        |                |
| Reference Books                                                                                                                                                                                  |                                                                                                                           |                |
| 1                                                                                                                                                                                                | B.KolmanandD.R.Hill, <i>IntroductoryLinearAlgebra</i> ,8thed.NewDelhi,India:PearsonEducation,2009.                        |                |
| 2                                                                                                                                                                                                | S. Kumaresan, <i>LinearAlgebra:AGEometricApproach</i> , Reprint, New Delhi, India: Prentice Hall of India, 2010.          |                |
| 3                                                                                                                                                                                                | R.Bronson, <i>Schaum'sOutlineofMatrixOperations</i> , 2nded.NewYork,NY,USA:McGraw-Hill, 2011.                             |                |
| 4                                                                                                                                                                                                | G. Strang, <i>LinearAlgebraandItsApplications</i> , 5thed.NewDelhi,India:PearsonEducation, 2023.                          |                |
| 5                                                                                                                                                                                                | V. Sundarapandian, <i>NumericalLinearAlgebra</i> ,NewDelhi,India:PHILearningPvt.Ltd., 2023.                               |                |
| Web References                                                                                                                                                                                   |                                                                                                                           |                |
| 1                                                                                                                                                                                                | <a href="https://archive.nptel.ac.in/courses/111/106/111106051">https://archive.nptel.ac.in/courses/111/106/111106051</a> |                |
| 2                                                                                                                                                                                                | <a href="https://onlinecourses.nptel.ac.in/noc24_ee48/preview">https://onlinecourses.nptel.ac.in/noc24_ee48/preview</a>   |                |
| 3                                                                                                                                                                                                | <a href="https://archive.nptelac.in/courses/111/107/111107106/">https://archive.nptelac.in/courses/111/107/111107106/</a> |                |

| Course Code                                                   | Course Name                                                                                                                                                                     | Semester | Category | Hours/Week |   |   | C    |
|---------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|------------|---|---|------|
|                                                               |                                                                                                                                                                                 |          |          | L          | T | P |      |
| 240E643                                                       | Advanced Engineering Chemistry                                                                                                                                                  |          | OE       | 3          | 0 | 0 | 3    |
| <b>Course Outcomes(s)</b>                                     |                                                                                                                                                                                 |          |          |            |   |   |      |
| Upon completion of the course, students shall have ability to |                                                                                                                                                                                 |          |          |            |   |   | RBT  |
| C01                                                           | Understand the basic principles of semiconductors, including periodic trends, band gaps, conductivity, and their applications in various electronic and optoelectronic devices. |          |          |            |   |   | [U]  |
| C02                                                           | Select appropriate modern engineering alloys based on their composition and properties for specific applications in electronics, telecommunications, and aerospace.             |          |          |            |   |   | [AP] |
| C03                                                           | Classify different types of refractories and abrasives and describe their properties and manufacturing processes with respect to industrial usage.                              |          |          |            |   |   | [U]  |
| C04                                                           | Describe the types and mechanisms of adsorption, interpret adsorption isotherms, and explain their significance in catalytic and surface chemistry applications.                |          |          |            |   |   | [U]  |
| C05                                                           | Apply suitable spectroscopic techniques such as UV-Visible, IR, XRD, and flame photometry for the qualitative and quantitative analysis of materials.                           |          |          |            |   |   | [AP] |

| CourseContent                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                              |                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|----------------|
| Unit –I                                                                                                                                                                                                                                                                                                                                                                               | ChemistryofSemiconductors                                                                                    | 09             |
| Semiconductors–Introduction– Periodic trends –Band gaps,conductivityandcoloursofsemiconductors – compoundsemiconductors–SemiconductorTechnology–AnoverviewofIntegratedcircuitdesignand fabrication– usesin FET–BJT,JFET,MOSFET–Semiconductorsintrafficlightsandelectronics,CD/DVDOptical discs, microchips in computersandcellphones, solarcells–amorphousseimiconductors –anoverview |                                                                                                              |                |
| Unit–II                                                                                                                                                                                                                                                                                                                                                                               | ModernEngineeringMaterials                                                                                   | 09             |
| Metals and Metallic properties–Alloys andNeed for Alloys–Modern Electronic gradealloys– Composition,PropertiesofAluminium,Silicon,Nickel,PhosphorusandCopperalloys– Applicationsinelectricalcomponents,transducers,electromagneticshieldingofcomputers,telecommunicationsequipm entandrocketmotorcasings.                                                                             |                                                                                                              |                |
| Unit–III                                                                                                                                                                                                                                                                                                                                                                              | RefractoriesandAbrasives                                                                                     | 09             |
| Refractories –classification –acidic,basic andneutral refractories –properties(refractoriness, refractoriness underload, dimensional stability,porosity, thermal spalling) –manufactureofalumina,magnesiteand zirconiabricks. Abrasives –natural and syntheticabrasives –quartz, corundum, emery,garnet,diamond, siliconcarbideandboron carbide.                                      |                                                                                                              |                |
| Unit–IV                                                                                                                                                                                                                                                                                                                                                                               | SurfaceChemistry                                                                                             | 09             |
| Adsorption–Classificationofadsorption–adsorptionofgasesonsolids–adsorptionofsolutesfromSolutions–Types ofadsorptionisotherms–FreundlichadsorptionIsotherm–Langmuir'stheoryofadsorption– Applicationsof adsorption – Role ofadsorbentsincatalysis.                                                                                                                                     |                                                                                                              |                |
| Unit –V                                                                                                                                                                                                                                                                                                                                                                               | SpectroscopicTechniques                                                                                      | 09             |
| Basic concepts of spectroscopy – Electromagnetic spectrum – Lambert andBeerslaw – AbsorptionandEmissionspectroscopy–DifferentspectroscopicTechniques–UV–Visible–IR–Colorimetry– Flamephotometry(BlockDiagram) – XRDtechnique.                                                                                                                                                         |                                                                                                              |                |
|                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                              | TOTAL: 45Hours |
| LearningResources                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                              |                |
| Textbooks                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                              |                |
| 1                                                                                                                                                                                                                                                                                                                                                                                     | DavidW.Greve,“SemiconductorDevicesand Technology”, SquirrelHillPublications,Pittsburg,USA,14thEdition, 2011. |                |
| 2                                                                                                                                                                                                                                                                                                                                                                                     | JainP. C.&MonicaJain.,“EngineeringChemistry”,17thEdition,DhanpatRaiPublishingCompany(P)Ltd,NewDelhi, 2015.   |                |
| 3                                                                                                                                                                                                                                                                                                                                                                                     | DaraS.S.,“ATextbookofEngineeringChemistry”, S.ChandPublications, 2004                                        |                |
| 4                                                                                                                                                                                                                                                                                                                                                                                     | ShashiChawla“ATextBookOfEngineeringChemistry”DhanpatRai&Co.(P)Limited, 2017                                  |                |
| ReferenceBooks                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                              |                |

|                      |                                                                                                                                                                     |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                    | JoellrwinGerstenandFrederickWilliamSmith, "ThePhysicsandChemistryofMaterials", Wiley Interscience, New Jersey, 12th Edition, 2012.                                  |
| 2                    | SivasankarB., "EngineeringChemistry", TataMcGraw-HillPublishingCompanyLtd, New Delhi, 2012.                                                                         |
| 3                    | FriedrichEmich, "EngineeringChemistry", Medtech, 2014.                                                                                                              |
| <b>WebReferences</b> |                                                                                                                                                                     |
| 1                    | <a href="https://learncheme.com/">https://learncheme.com/</a>                                                                                                       |
| 2                    | <a href="https://www.coursera.org/browse/physical-science-and-engineering/chemistry">https://www.coursera.org/browse/physical-science-and-engineering/chemistry</a> |
| 3                    | <a href="http://www.cheresources.com/">http://www.cheresources.com/</a>                                                                                             |

| Course Code                                                   | Course Name                                                                                                                                | Semester | Category | Hours/Week |   |   | C    |
|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|------------|---|---|------|
|                                                               |                                                                                                                                            |          |          | L          | T | P |      |
| 240E644                                                       | Nanotechnology And NLO Materials                                                                                                           |          | OE       | 3          | 0 | 0 | 3    |
| <b>Course Outcomes(s)</b>                                     |                                                                                                                                            |          |          |            |   |   |      |
| Upon completion of the course, students shall have ability to |                                                                                                                                            |          |          |            |   |   | RBT  |
| C01                                                           | Understand the basic concepts of nanotechnology.                                                                                           |          |          |            |   |   | [U]  |
| C02                                                           | Explained the method of synthesizing nanostructures with desired size, shape, and surface properties.                                      |          |          |            |   |   | [AP] |
| C03                                                           | Apply characterization results to optimize the synthesis process and enhance the functionality of nanomaterials for targeted applications. |          |          |            |   |   | [AP] |
| C04                                                           | Utilize nanomaterials for the design of high-performance sensing devices.                                                                  |          |          |            |   |   | [AP] |
| C05                                                           | Utilize nonlinear optical concepts to enhance and develop technologies in recent engineering.                                              |          |          |            |   |   | [AP] |

| <b>Course Content</b>                                                                                                                                                                                                                                                                                                                                                                               |                                                            |                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|------------------------|
| <b>Unit-I</b>                                                                                                                                                                                                                                                                                                                                                                                       | <b>INTRODUCTION TO NANOMATERIALS</b>                       | <b>09</b>              |
| History of nanomaterials, Classification of Nanomaterials, Scientific Revolutions, Nanotechnology and Nanomachines, The Periodic Table, Atomic Structure, Energy, Molecular and Atomic size, Surfaces and Dimensional Space.                                                                                                                                                                        |                                                            |                        |
| <b>Unit-II</b>                                                                                                                                                                                                                                                                                                                                                                                      | <b>SYNTHESIS METHOD OF NANOMATERIALS</b>                   | <b>09</b>              |
| Top down and Bottom-up approach, Ball Milling, Electrospinning, Lithographic techniques, Mechanical milling, Etching, Sputtering, Laser Ablation, Molecular beam epitaxy, CVD, Arc discharge, Flame synthesis, spray pyrolysis and solvated metal atom dispersion, Sol-Gel, Electrodeposition.                                                                                                      |                                                            |                        |
| <b>Unit-III</b>                                                                                                                                                                                                                                                                                                                                                                                     | <b>BASICS OF NANOMATERIALS CHARACTERIZATION TECHNIQUES</b> | <b>09</b>              |
| UV-Visible Spectroscopy, Fourier Transform infrared (FTIR) spectroscopy, Raman spectroscopy-X-ray Photoelectron Spectroscopy (XPS), Energy Dispersive X-ray analysis (EDAX), microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM), Scanning tunneling microscopy (STM). Resistivity by Four Point Probe method, Hall measurement.                                |                                                            |                        |
| <b>Unit-IV</b>                                                                                                                                                                                                                                                                                                                                                                                      | <b>NANOMATERIALS AND APPLICATIONS</b>                      | <b>09</b>              |
| Sensors, Nanotechnology Enabled Sensors, Sensor Characteristics and Terminology, Static Characteristics, Dynamic Characteristics, Resistive and Capacitive Gas Sensors, Potentiometric Sensors, Amperometric Sensors, Electro-Chemical Biosensors.                                                                                                                                                  |                                                            |                        |
| <b>Unit-V</b>                                                                                                                                                                                                                                                                                                                                                                                       | <b>NONLINEAR OPTICS AND APPLICATIONS</b>                   | <b>09</b>              |
| Nonlinear Optics: Nonlinear Susceptibility, 2nd order nonlinear effect - Optical Rectification, 2nd harmonic generation, Nonlinear Maxwell's equation, Concept of phase matching Birefringence Phase Matching (BPM), Kleinman symmetry, Index contraction, d-matrix, Quasi Phase Matching (QPM), Optical Parametric Oscillator (OPO), Singly Resonant Oscillator (SRO), Doubly Resonant Oscillator. |                                                            |                        |
|                                                                                                                                                                                                                                                                                                                                                                                                     |                                                            | <b>TOTAL: 45 Hours</b> |

| <b>Learning Resources</b> |                                                                                                                                        |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Textbooks</b>          |                                                                                                                                        |
| 1                         | A textbook of Nano science and Nanotechnology, Pradeep.T, Tata McGraw-Hill Education private Ltd, 2012.                                |
| 2                         | Nanostructured materials: Processing, Properties and Potential Applications, edited by C.C. Koch, Noyes Publications, 2002.            |
| 3                         | Inorganic Materials Synthesis and Fabrication by J.N. Lalena, D.A. Cleary, E.E. Carpenter, N.F. Dean, John Wiley & Sons Inc, 2008.     |
| 4                         | Characterization of nanostructured materials by Z.L. Wang, Wiley India, 1999.                                                          |
| 5                         | Nanotechnology-Enabled Sensors, Kourosh Kalantar-zadeh, Springer publications, 2007.                                                   |
| 6                         | Chemical Sensors - An Introduction for Scientists and Engineers, Peter Grundle, Springer publications, 2006.                           |
| 7                         | Nonlinear Optics. Third Edition. Robert W. Boyd. The Institute of Optics. University of Rochester. Rochester, NY, United States, 2008. |
| 8                         | Introduction to nonlinear optics by Geoffrey New, Imperial College of Science, Technology and Medicine, London, 2011.                  |
| <b>Reference Books</b>    |                                                                                                                                        |
| 1                         | Nanotechnology: Principles and Practices - Sulabha K. Kulkarni - Capital Publishing Company, 2015.                                     |

|                |                                                                                                                                                                                                                                                                                                                                   |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2              | Design and Applications of Nanomaterials for Sensors by Jorge M. Seminario, Jerzy Leszczynski, Springer, Volume-16, 2014.                                                                                                                                                                                                         |
| 3              | Fundamentals of nonlinear optics (2nd Ed.) by Peter E. Powers, Joseph W. Haus, CRC Press, 2017.                                                                                                                                                                                                                                   |
| 4              | Nonlinear Optics: Principles and Applications by K. Rottwitt, P. Tidemand-Lichtenberg, CRC Press, 2014.                                                                                                                                                                                                                           |
| 5              | Introduction to Nanoscience, S. M. Lindsay, Oxford University Press, 2010.                                                                                                                                                                                                                                                        |
| 6              | Encyclopedia of Nano Technology by M. Balakrishna Rao and K. Krishna Reddy, Vol 1 to X, Cumpus Books International, 2006.                                                                                                                                                                                                         |
| 7              | A practical approach to X-Ray diffraction analysis by C. Suryanarayana, Plenum Press, New York, 1998.                                                                                                                                                                                                                             |
| 8              | Atomic and Molecular Spectroscopy: Basic Aspects and Applications by S. Svanberg, Springer, 2001.                                                                                                                                                                                                                                 |
| Web References |                                                                                                                                                                                                                                                                                                                                   |
| 1              | <a href="https://archive.nptel.ac.in/courses/118/102/118102003/#">https://archive.nptel.ac.in/courses/118/102/118102003/#</a>                                                                                                                                                                                                     |
| 2              | <a href="https://archive.nptel.ac.in/courses/115/105/115105105/">https://archive.nptel.ac.in/courses/115/105/115105105/</a>                                                                                                                                                                                                       |
| 3              | <a href="https://archive.nptel.ac.in/courses/115/101/115101008/#">https://archive.nptel.ac.in/courses/115/101/115101008/#</a>                                                                                                                                                                                                     |
| 4              | <a href="https://ocw.mit.edu/courses/2-57-nano-to-macro-transport-processes-spring-2012/resources/lecture-1-intro-to-nanotechnology-nanoscale-transport-phenomena/">https://ocw.mit.edu/courses/2-57-nano-to-macro-transport-processes-spring-2012/resources/lecture-1-intro-to-nanotechnology-nanoscale-transport-phenomena/</a> |

| CourseCode                                                | CourseName                                                                         | Category | Hours/Week |   |   | C          |
|-----------------------------------------------------------|------------------------------------------------------------------------------------|----------|------------|---|---|------------|
|                                                           |                                                                                    |          | L          | T | P |            |
| 240E645                                                   | EnglishforCompetitiveExaminations                                                  | HS       | 3          | 0 | 0 | 3          |
| <b>CourseOutcomes(s)</b>                                  |                                                                                    |          |            |   |   |            |
| <b>Uponcompletionofthecourse,studentsshallhaveability</b> |                                                                                    |          |            |   |   | <b>RBT</b> |
| C114.1                                                    | UnderstandingofcommonEnglishwordsandphrases, buildingtheirvocabularytocommunicate. |          |            |   |   | AP         |
| C114.2                                                    | Recognizedifferenttypesofsentencestructures.                                       |          |            |   |   | AP         |
| C114.3                                                    | Learntowriteprecisandnoteswithclarity.                                             |          |            |   |   | AP         |
| C114.4                                                    | Expressideasinaclearandconcisemanner.                                              |          |            |   |   | AP         |
| C114.5                                                    | Gainaclearunderstandingintheuseofprepositionsandelimatecommonerrors.               |          |            |   |   | AP         |

| CourseContent                                                                                                                                            |                                                                                                                                                 |               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Unit-1                                                                                                                                                   | INTRODUCTIONTOBASICSOFENGLISH                                                                                                                   | 9             |
| Differentkindsof Tenses, Typesof Sentences,Phrase,Adverb&PhrasesandIdioms. SynonymsandAntonyms.                                                          |                                                                                                                                                 |               |
| Unit-2                                                                                                                                                   | TRANSFORMATIONOFSENTENCE                                                                                                                        | 9             |
| Transformationofsimple,Compoundandcomplexsentences,Transformationofcommunicationclassificationof sentences& TransformationofDegree. SynonymsAndAntonyms. |                                                                                                                                                 |               |
| Unit-3                                                                                                                                                   | PRECISANDNOTEWRITING                                                                                                                            | 9             |
| Precise writing,Notemaking,ParagraphWriting&EssayWriting. SynonymsAndAntonyms.                                                                           |                                                                                                                                                 |               |
| Unit-4                                                                                                                                                   | COMPREHENSIONANDLETTERANDREPORTWRITING                                                                                                          | 9             |
| Comprehension,LetterWriting&ReportWriting. SynonymsAndAntonyms.                                                                                          |                                                                                                                                                 |               |
| Unit-5                                                                                                                                                   | COMMONERRORSANDUSEOFPREPOSITIONS                                                                                                                | 9             |
| MatchWordsWithTheirMeanings, SpottingCommonErrorsInEnglishGrammar, AppropriateUseOf Prepositions. SynonymsAnd Antonyms.                                  |                                                                                                                                                 |               |
|                                                                                                                                                          |                                                                                                                                                 | TOTAL:45Hours |
| LearningResources                                                                                                                                        |                                                                                                                                                 |               |
| Textbooks                                                                                                                                                |                                                                                                                                                 |               |
| 1                                                                                                                                                        | K.S.Sinha, <i>TheKing'sGrammar</i> .NewDelhi,India:BlackieELTBooks,2008.                                                                        |               |
| 2                                                                                                                                                        | C.D. Sidhu,P.Nath,andK.Kapoor, <i>ComprehensiveEnglishGrammarandComposition</i> .NewDelhi,India:KhoslaPublishingHouse,2004.                     |               |
| 3                                                                                                                                                        | P.C. WrenandH.Martin, <i>HighSchoolEnglishGrammar&amp;Composition</i> .NewDelhi,India:S.Chand &Company,2007.                                    |               |
| ReferenceBooks                                                                                                                                           |                                                                                                                                                 |               |
| 1                                                                                                                                                        | C.Baldick, <i>TheOxfordDictionaryofLiteraryTerms</i> .Oxford,U.K.:OxfordUniversityPress,2009.                                                   |               |
| 3                                                                                                                                                        | J.Mathew, <i>FineTuneYourEnglish</i> .NewDelhi,India: OrientBlackswanPvt.Ltd.,2010.                                                             |               |
| WebReferences                                                                                                                                            |                                                                                                                                                 |               |
| 1                                                                                                                                                        | <a href="https://byjus.com/govt-exams/general-english-competitive-exams//">https://byjus.com/govt-exams/general-english-competitive-exams//</a> |               |

## APPENDIX

### A. Knowledge and Attitude Profile (WK)

| WK  | Knowledge and Attitude Profile                                                                                                                                                                                                                                      |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WK1 | Asystematic,theory-basedunderstandingofthenaturalsciencesapplicabletothediscipline and awareness of relevant social sciences.                                                                                                                                       |
| WK2 | Conceptually-based mathematics, numerical analysis,dataanalysis,statisticsandformalaspectsof computerandinformationscience tosupportdetailedanalysisand modellingapplicabletothediscipline.                                                                         |
| WK3 | Asystematic,theory-basedformulationof engineeringfundamentalsrequiredintheengineering discipline.                                                                                                                                                                   |
| WK4 | Engineering specialist knowledge that provides theoretical frameworksand bodiesof knowledgefortheacceptedpracticeareasintheengineeringdiscipline; muchisattheforefront ofthe discipline.                                                                            |
| WK5 | Knowledge,includingefficientresourceuse,environmentalimpacts,whole-lifecost,re-useof resources,net zerocarbon,andsimilarconcepts, thatsupportsengineering designandoperationsinapracticearea.                                                                       |
| WK6 | Knowledgeofengineeringpractice (technology)inthepracticeareasinthe engineering discipline.                                                                                                                                                                          |
| WK7 | Knowledgeof theroleof engineeringinsocietyandidentifiedissuesinengineering practiceinthediscipline,suchastheprofessionalresponsibilityofanengineerto public safety and sustainable development.                                                                     |
| WK8 | Engagementwithselectedknowledgeinthecurrentresearchliteratureofthediscipline ,awarenessofthepowerofcriticalthinkingandcreativeapproachestoevaluate emerging issues.                                                                                                 |
| WK9 | Ethics,inclusivebehaviorandconduct.Knowledgeofprofessionalethics,responsibiliti es, and normsofengineeringpractice.Awarenessof theneedfor diversitybyreasonofethnicity,gender, age,physicalabilityetc. withmutual understandingandrespect, andofinclusiveattitudes. |

### B. BLOOMSTAXONOMY

AccordingtorevisedBloomstaxonomythelevelsinthecognitivedomainareasfollows:

| Level | Descriptor    | Levelofattainment                                                       |
|-------|---------------|-------------------------------------------------------------------------|
| 1     | Remembering   | Recallingfromthememoryofthepreviouslylearnedmaterial                    |
| 2     | Understanding | Explainingideasorconcepts                                               |
| 3     | Applying      | Using the information in another familiar situation                     |
| 4     | Analysing     | Breakinginformationintothe parttoexploreunderstanding and relationships |
| 5     | Evaluating    | Justifyingadecisionorcourseofaction                                     |

|   |          |                                                              |
|---|----------|--------------------------------------------------------------|
| 6 | Creating | Generating new ideas, products or new ways of viewing things |
|---|----------|--------------------------------------------------------------|



Bloom's taxonomy is hierarchical, meaning that learning at the higher level requires that skills at a lower level are attained.

**As per the Examination Reform Policy following are the Action Verbs for Assessment**

| Level         | Question cues/Verbs for tests                                                                                                                                   |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Remember   | list, define, tell, describe, recite, recall, identify, show, label, tabulate, quote, name, who, when, where                                                    |
| 2. Understand | describe, explain, paraphrase, restate, associate, contrast, summarize, differentiate, interpret, discuss                                                       |
| 3. Apply      | calculate, predict, apply, solve, illustrate, use, demonstrate, determine, model, experiment, show, examine, modify                                             |
| 4. Analyse    | classify, outline, breakdown, categorize, analyze, diagram, illustrate, infer, select                                                                           |
| 5. Evaluate   | assess, decide, choose, rank, grade, test, measure, defend, recommend, convince, select, judge, support, conclude, argue, justify, compare, summarize, evaluate |
| 6. Create     | design, formulate, build, invent, create, compose, generate, derive, modify, develop, integrate                                                                 |