



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



DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM AND SYLLABI

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATION 2024

CHOICE BASED CREDIT SYSTEM

(For students to be admitted from 2024 – 2025 onwards)



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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CHOICE BASED CREDIT SYSTEM

Regulations 2024

CURRICULUM AND SYLLABI

(Candidates admitted during Academic Year 2024-2025)

BRANCH: B.E. - ELECTRONICS AND COMMUNICATION ENGINEERING - FULL TIME

KATHIR COLLEGE OF ENGINEERING**COIMBATORE-641062****DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING****CHOICE BASED CREDIT SYSTEM****2024 Regulations, Curriculum & Syllabi****(For the batches of students admitted in 2024 - 2025 and subsequently)****BRANCH: B.E. - ELECTRONICS AND COMMUNICATION ENGINEERING -
FULL TIME****I.VISION OF THE INSTITUTION**

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

II.MISSION OF THE INSTITUTION

- 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

III.VISION OF THE DEPARTMENT

Producing technically competent Electronics and Communication Engineers to excel in research and product development with ethical values, social responsibilities and entrepreneurial skills

IV. MISSION OF THE DEPARTMENT

- Providing stake holders an academic ambience to acquire Higher Order Thinking Skills to be technically competent
- Imparting required skills in niche areas through our Industry driven Centres of Excellence.
- Nurturing critical and creative thinking skills to innovate new ideas for solving societal problems and become successful entrepreneurs

V. PROGRAM EDUCATIONAL OBJECTIVES

PEO1	Graduates will have a successful career in academia / Industry / Entrepreneurship.
PEO2	Graduates will excel both individually and in multidisciplinary teams to solve industry and societal problems.
PEO3	Graduates will exhibit lifelong learning skills with ethical values.

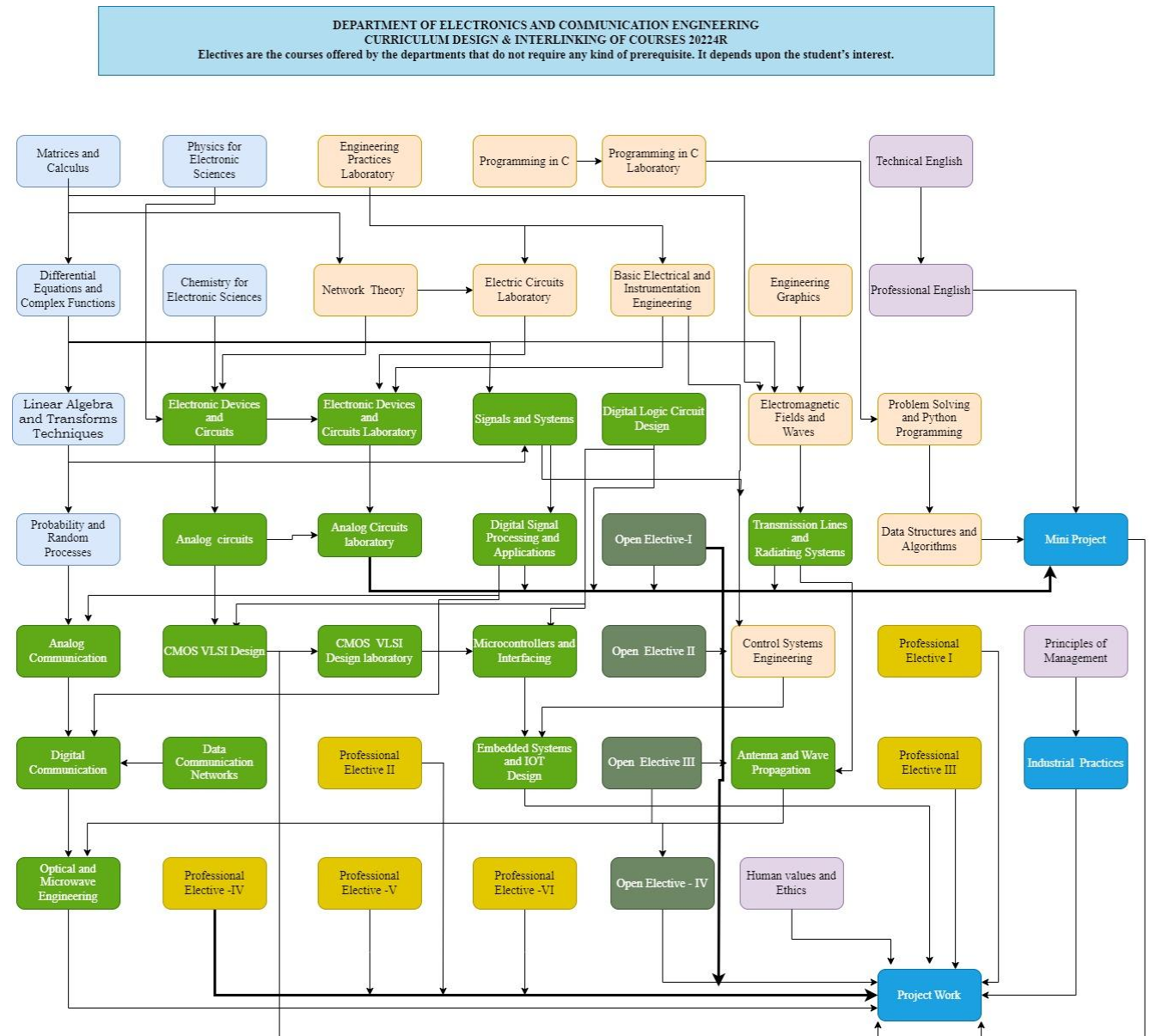
VI. PROGRAM OUTCOMES

PO1	Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2	Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3	Design/development of solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4	Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO5	Engineering tool usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6	The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO7	Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8	Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10	Project management and finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	Life-long learning: Recognize the need for, and have the preparation and ability for

	i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)
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VII.PROGRAM SPECIFIC OUTCOMES (PSOS)

PSO1	Apply Principles of Electronics, mathematics and engineering to design, develop and analyze electronic systems.
PSO2	Utilize communication principles, signal processing to design, develop and communication systems.



REGULATIONS 2024
B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
CURRICULUM FOR I TO VIII SEMESTERS
(For the batches of students admitted in 2024 - 2025 and subsequently)

SEMESTER I									
SL. No.	Course Code	Course	L/T/P			Contact hrs./wk.	C	Ext./Int.	Cat.
THEORY									
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
THEORY CUM PRACTICAL									
3	24BP213	Physics for Electronic Sciences	3	0	2	5	4	40/60	BS
4	24HS114	Technical English	2	0	2	4	3	40/60	HS
PRACTICAL COURSE									
5	24EP315	Engineering Practices Laboratory	0	0	4	4	2	40/60	ES
6	24CS316	Programming in C Laboratory	0	0	4	4	2	40/60	ES
MANDATORY COURSE									
7	24MC901	Mandatory Course I Induction program	Three week program				0	-	MC
TOTAL			11	1	12	24	18	600	-

SEMESTER II									
SL. No.	Course Code	Course	L/T/P			Contact hrs./wk.	C	Ext./Int.	Cat.
THEORY									
1	24MA221	Differential Equations and Complex Functions	3	1	0	4	4	60/40	BS
2	24EE322	Basic Electrical and Instrumentation Engineering	3	0	0	3	3	60/40	ES
3	24EE323	Network Theory	3	0	0	3	3	60/40	ES
THEORY CUM PRACTICAL									
4	24HS124	Professional English	2	0	2	4	3	40/60	HS
5	24EG315	Engineering Graphics	1	0	4	5	3	40/60	ES
6	24BC226	Chemistry for Electronic Sciences	3	0	2	5	4	40/60	BS
PRACTICAL COURSE									
7	24EE327	Electric Circuits Laboratory	0	0	4	4	2	40/60	ES
MANDATORY COURSE									
8	24MC902	Mandatory Course II Heritage of Tamils	2	0	0	2	0	-	MC
TOTAL			17	1	12	30	22	700	-

SEMESTER III										
SL. No.	Course Code	Course	L/T/P			Contact hrs./wk.	C	Ext./Int.	Cat.	
THEORY										
1	24MA233	Linear Algebra and Transforms Techniques	3	1	0	4	4	60/40	BS	
2	24EE332	Electromagnetic Fields and Waves	3	1	0	4	4	60/40	ES	
3	24EC433	Electronic Devices and Circuits	3	0	0	3	3	60/40	PC	
THEORY CUM PRACTICAL										
4	24EC434	Digital Logic Circuit Design	3	0	2	5	4	40/60	PC	
5	24EC435	Signals and Systems	3	0	2	5	4	40/60	PC	
6	24CS336	Problem Solving and Python Programming	3	0	2	5	4	40/60	ES	
PRACTICAL COURSE										
7	24EC437	Electronic Devices and Circuits Laboratory	0	0	4	4	2	40/60	PC	
MANDATORY COURSE										
8	24MC903	Mandatory Course III Environmental Science and Sustainability	2	0	0	2	0	-	MC	
TOTAL			20	2	10	32	25	700	-	

SEMESTER IV										
SL. No.	Course Code	Course	L/T/P			Contact hrs./wk.	C	Ext./Int.	Cat.	
THEORY										
1	24MA243	Probability and Random Processes	3	1	0	4	4	60/40	BS	
2	24EC442	Analog Circuits	3	0	0	3	3	60/40	PC	
3	24EC443	Transmission Lines and Radiating Systems	3	1	0	4	4	60/40	PC	
4	24OE6XX	Open Elective I	3	0	0	3	3	60/40	OE	
THEORY CUM PRACTICAL										
5	24EC445	Digital Signal Processing and Applications	3	0	2	5	4	40/60	PC	
6	24CS346	Data Structures and Algorithms	3	0	2	5	4	40/60	ES	
PRACTICAL COURSE										
7	24EC447	Analog Circuits Laboratory	0	0	4	4	2	40/60	PC	
8	24EC748	Mini Project	0	0	2	2	1	40/60	PW	
MANDATORY COURSE										
9.	24MC904	Mandatory Course IV Introduction to Women and Gender Studies	2	0	0	2	0	-	MC	
TOTAL			20	2	10	32	25	800	-	

SEMESTER V									
SL. No.	Course Code	Course	L	T	P	Contact hrs./wk.	C	Ext./Int.	Cat.
THEORY									
1	24MB151	Principles of Management	3	0	0	3	3	60/40	HS
2	24EE352	Control Systems Engineering	3	1	0	4	4	60/40	ES
3	24EC453	CMOS VLSI Design	3	0	0	3	3	60/40	PC
4	24EC5XX	Professional Elective I	3	0	0	3	3	60/40	PE
5	24OE6XX	Open Elective II	3	0	0	3	3	60/40	OE
THEORY CUM PRACTICAL									
6	24EC456	Analog Communication	3	0	2	5	4	40/60	PC
7	24EC457	Microcontrollers and Interfacing	3	0	2	5	4	40/60	PC
PRACTICAL COURSE									
8	24EC458	CMOS VLSI Design Laboratory	0	0	4	4	2	40/60	PC
TOTAL			21	1	8	30	26	800	-

SEMESTER VI									
SL. No.	Course Code	Course	L	T	P	Contact hrs./wk.	C	Ext./Int.	Cat.
THEORY									
1	24EC461	Antennas and Wave Propagation	3	0	0	3	3	60/40	PC
2	24EC462	Data Communication Networks	3	0	0	3	3	60/40	PC
3	24EC5XX	Professional Elective II	3	0	0	3	3	60/40	PE
4	24EC5XX	Professional Elective III	3	0	0	3	3	60/40	PE
5	24OE6XX	Open Elective III	3	0	0	3	3	60/40	OE
THEORY CUM PRACTICAL									
6	24EC466	Digital Communication	3	0	2	5	4	40/60	PC
7	24EC467	Embedded Systems and IoT Design	3	0	2	5	4	40/60	PC
PRACTICAL COURSE									
8	24EC861	Industrial Practices	0	0	0	0	2	0/100	IP
TOTAL			21	0	4	25	25	800	-

SEMESTER VII									
SL. No.	Course Code	Course	L	T	P	Contact hrs./wk.	C	Ext./Int.	Cat.
THEORY									
1	24HS171	Human Values and Ethics	2	0	0	2	2	60/40	HS
2	24EC472	Optical and Microwave Engineering	3	0	0	3	3	60/40	PC
3	24EC5XX	Professional Elective IV	3	0	0	3	3	60/40	PE
4	24EC5XX	Professional Elective V	3	0	0	3	3	60/40	PE
5	24EC5XX	Professional Elective VI	3	0	0	3	3	60/40	PE
6.	24OE6XX	Open Elective IV	3	0	0	3	3	60/40	OE
TOTAL			17	0	0	17	17	600	-

SEMESTER VIII									
SL. No.	Course Code	Course	L	T	P	Contact hrs./wk.	C	Ext./Int.	Cat.
PROJECT									
1	24EC781	Project Work	0	0	24	24	12	40/60	PW
TOTAL			0	0	24	24	12	100	

STRUCTURE FOR B. E ECE PROGRAMME

S.No.	Course Work - Subject Area	AICTE Credits(160)	KCE Credits (170)
1.	Humanities and Social Sciences including Management courses	12*	11
2.	Basic Science courses	25*	24
3.	Engineering Science courses including Workshop, Drawing, Basics of Electrical / Mechanical / Computer	24*	34
4.	Professional core courses	48*	56
5.	Professional Electives courses relevant to the chosen specialization / branch	18*	18
6.	Open Subjects- Electives from other technical and / or emerging subjects	18*	12
7.	Project Work, Seminar and / or Internship in Industry or elsewhere ,Employability Skills	15*	15
8.	Mandatory Courses	Non Credit	
Total		160*	170

CREDIT DISTRIBUTION - SUMMARY

SL. No.	Stream	Credits/Semester								C	%
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities (HS)	3	3			3		2		11	6.47
2	Basic Sciences(BS)	8	8	4	4					24	14.12
3	Engineering Sciences(ES)	7	11	8	4	4				34	20.00
4	Programme Core(PC)			13	13	13	14	3		56	32.94
5	Professional Electives(PE)					3	6	9		18	10.59
6	Open Electives(OE)				3	3	3	3		12	7.06
7	Project Work(PW)				1				12	13	7.64
8	Industrial Practices (IP)						2			2	1.18
9	Mandatory Course((MC)	0	0	0	0					0	0
Total		18	22	25	25	26	25	17	12	170	100

SUBJECT DISTRIBUTION - SUMMARY

SL. No.	Stream	Number of Subject/Semester								Number of subjects	%
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities (HS)	1	1			1		1		4	7.27
2	Basic Sciences(BS)	2	2	1	1					6	10.90
3	Engineering Sciences(ES)	3	4	2	1	1				11	20.00
4	Programme Core(PC)			4	4	4	4	1		17	30.90
5	Professional Electives(PE)					1	2	3		6	10.90
6	Open Electives(OE)				1	1	1	1		4	7.27
7	Project Work(PW)				1				1	2	3.63
8	Industry Practices (IP)						1			1	1.82
9	Mandatory Course (MC)	1	1	1	1					4	7.27
Total		7	8	8	9	8	8	6	1	55	100

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT (11 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1	24HS114	Technical English	2/0/2	4	3	HS
2	24HS124	Professional English	2/0/2	4	3	HS
3	24MB151	Principles of Management	3/0/0	3	3	HS
4	24HS171	Human Values and Ethics	2/0/0	2	2	HS

BASIC SCIENCE COURSES (24 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	24MA211	Matrices and Calculus	3/1/0	4	4	BS
2.	24BP213	Physics for Electronic Sciences	3/0/2	5	4	BS
3.	24MA221	Differential Equations and Complex Functions	3/1/0	4	4	BS
4.	24BC226	Chemistry for Electronic Sciences	3/0/2	5	4	BS
5.	24MA233	Linear Algebra and Transforms Techniques	3/1/0	4	4	BS
6.	24MA243	Probability and Random Processes	3/1/0	4	4	BS

ENGINEERING SCIENCE COURSES (34 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	24CS312	Programming in C	3/0/0	3	3	ES
2.	24EP315	Engineering Practices Laboratory	0/0/4	4	2	ES
3.	24CS316	Programming in C Laboratory	0/0/4	4	2	ES
4.	24EE322	Basic Electrical and Instrumentation Engineering	3/0/0	3	3	ES
5.	24EE323	Network Theory	3/0/0	3	3	ES
6.	24EG315	Engineering Graphics	1/0/4	5	3	ES
7.	24EE327	Electric Circuits Laboratory	0/0/4	4	2	ES
8.	24EE332	Electromagnetic Fields and Waves	3/1/0	4	4	ES
9.	24CS336	Problem Solving and Python Programming	3/0/2	5	4	ES
10.	24CS346	Data Structures and Algorithms	3/0/2	5	4	ES
11.	24EE352	Control Systems Engineering	3/1/0	4	4	ES

PROGRAMME CORE COURSES (56 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	24EC433	Electronic Devices and Circuits	3/0/0	3	3	PC
2.	24EC434	Digital Logic Circuit Design	3/0/2	5	4	PC
3.	24EC435	Signals and Systems	3/0/2	5	4	PC
4.	24EC437	Electronic Devices and Circuits Laboratory	0/0/4	4	2	PC
5.	24EC442	Analog Circuits	3/0/0	3	3	PC
6.	24EC443	Transmission lines and Radiating Systems	3/1/0	4	4	PC
7.	24EC445	Digital Signal Processing and Applications	3/0/2	5	4	PC
8.	24EC447	Analog Circuits Laboratory	0/0/4	4	2	PC
9.	24EC453	CMOS VLSI Design	3/0/0	3	3	PC
10.	24EC456	Analog Communication	3/0/2	5	4	PC
11.	24EC457	Microcontrollers and Interfacing	3/0/2	5	4	PC
12.	24EC458	CMOS VLSI Design Laboratory	0/0/4	4	2	PC
13.	24EC461	Antennas and Wave Propagation	3/0/0	3	3	PC
14.	24EC462	Data Communication Networks	3/0/0	3	3	PC
15.	24EC466	Digital Communication	3/0/2	5	4	PC
16.	24EC467	Embedded Systems and IoT Design	3/0/2	5	4	PC
17.	24EC472	Optical and Microwave Engineering	3/0/0	3	3	PC

PROFESSIONAL ELECTIVE COURSES (18 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
VLSI Design and Embedded Systems						
1.	24EC501	ASIC Design	3/0/0	3	3	PE
2.	24EC502	Low Power VLSI	3/0/0	3	3	PE
3.	24EC503	Modelling and Synthesis with HDL	3/0/0	3	3	PE
4.	24EC504	Computer Architecture	3/0/0	3	3	PE
5.	24EC505	Communication Protocols and Standards	3/0/0	3	3	PE
6.	24EC506	Embedded C Programming	3/0/0	3	3	PE
Advanced Communication Systems						

7.	24EC507	Wireless Communication Systems	3/0/0	3	3	PE
8.	24EC508	Satellite Communication	3/0/0	3	3	PE
9.	24EC509	Fiber Optic Communication	3/0/0	3	3	PE
10.	24EC510	Electromagnetic Interference and Compatibility	3/0/0	3	3	PE
11.	24EC511	Antenna Technologies for Wireless Applications	3/0/0	3	3	PE
12.	24EC512	Machine Learning for Wireless Communication	3/0/0	3	3	PE
Signal Processing						
13.	24EC513	Statistical Signal Processing	3/0/0	3	3	PE
14.	24EC514	Speech Signal Processing	3/0/0	3	3	PE
15.	24EC515	Digital Image Processing	3/0/0	3	3	PE
16.	24EC516	Computer Vision and Its Applications	3/0/0	3	3	PE
17.	24EC517	Multimedia Compression Techniques	3/0/0	3	3	PE
18.	24EC518	Wavelets and Its Applications	3/0/0	3	3	PE
Networks						
19.	24EC519	Wireless Sensor Networks	3/0/0	3	3	PE
20.	24EC520	Network and Security	3/0/0	3	3	PE
21.	24EC521	Software Defined Networks	3/0/0	3	3	PE
22.	24EC522	Massive MIMO Networks	3/0/0	3	3	PE
23.	24EC523	4G/5G Communication Networks	3/0/0	3	3	PE
24.	24EC524	Photonics Networks	3/0/0	3	3	PE
Bio Medical Technologies						
25.	24EC525	Medical Electronics	3/0/0	3	3	PE
26.	24EC526	Wearable Devices	3/0/0	3	3	PE
27.	24EC527	Human Assist Devices	3/0/0	3	3	PE
28.	24EC528	Medical Imaging Systems	3/0/0	3	3	PE
29.	24EC529	Brain Computer Interface and Applications	3/0/0	3	3	PE
30.	24EC530	Body Area Networks	3/0/0	3	3	PE

OPEN ELECTIVE COURSES OFFERED BY ECE FOR OTHER DEPARTMENTS

ECE ELECTIVES						
1.	24OE621	Introduction to VLSI design	3/0/0	3	3	OE
2.	24OE622	Communication Engineering	3/0/0	3	3	OE
3.	24OE623	Sensors and Actuators	3/0/0	3	3	OE
4.	24OE624	Basics of Hardware Description Languages	3/0/0	3	3	OE
5.	24OE625	Introduction to Internet of Things	3/0/0	3	3	OE

OPEN ELECTIVE COURSES(OE) (15 CREDITS)

SL No	Code	Course Name	L/T/P	Contact hrs./Wk.	C	Cat.
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	24OE606	Fundamentals of Computer vision	3/0/0	3	3	OE
7	24OE607	Machine Learning and its applications	3/0/0	3	3	OE
8	24OE608	Deep Learning Techniques	3/0/0	3	3	OE
9	24OE609	Language Engineering	3/0/0	3	3	OE
10	24OE610	Neural Networks	3/0/0	3	3	OE
11	24OE611	Database Fundamentals	3/0/0	3	3	OE
12	24OE612	Basics of Image Processing	3/0/0	3	3	OE
13	24OE613	Agile Methodologies	3/0/0	3	3	OE
14	24OE614	Web Technology Fundamentals	3/0/0	3	3	OE
15	24OE615	App development Fundamentals	3/0/0	3	3	OE
16	24OE616	Introduction to Augmented Reality/Virtual Reality	3/0/0	3	3	OE
17	24OE617	Software Engineering	3/0/0	3	3	OE
18	24OE618	Foundation of Cloud Computing	3/0/0	3	3	OE
19	24OE619	Java Programming	3/0/0	3	3	OE
20	24OE620	Block Chain Technology	3/0/0	3	3	OE
21	24OE621	Introduction to VLSI design	3/0/0	3	3	OE
22	24OE622	Communication Engineering	3/0/0	3	3	OE
23	24OE623	Sensors and Actuators	3/0/0	3	3	OE
24	24OE624	Basics of Hardware Description Languages	3/0/0	3	3	OE
25	24OE625	Introduction to Internet of Things	3/0/0	3	3	OE
26	24OE626	Industrial Automation with PLC and SCADA	3/0/0	3	3	OE
27	24OE627	Electric Vehicle Technology	3/0/0	3	3	OE
28	24OE628	Energy Technology	3/0/0	3	3	OE
29	24OE629	Battery Management Systems	3/0/0	3	3	OE
30	24OE630	Power Converters for Electrical Appliances	3/0/0	3	3	OE
31	24OE631	Foundation of Robotics	3/0/0	3	3	OE
32	24OE632	Drone Technologies	3/0/0	3	3	OE
33	24OE633	Industrial Management	3/0/0	3	3	OE
34	24OE634	Additive Manufacturing	3/0/0	3	3	OE
35	24OE635	3D Printing	3/0/0	3	3	OE
36	24OE636	Fundamentals of Operations Research	3/0/0	3	3	OE
37	24OE637	Organizational Behaviour	3/0/0	3	3	OE
38	24OE638	Total Quality Management	3/0/0	3	3	OE
39	24OE639	Intellectual Property Rights	3/0/0	3	3	OE

40	24OE640	Emotional Intelligence	3/0/0	3	3	OE
41	24OE641	Algebra and Number Theory	3/0/0	3	3	OE
42	24OE642	Linear Algebra	3/0/0	3	3	OE
43	24OE643	Advanced Engineering Chemistry	3/0/0	3	3	OE
44	24OE644	Nanotechnology and NLO Materials	3/0/0	3	3	OE
45	24OE645	English for Competitive Examinations	3/0/0	3	3	OE

PROJECT WORK (15 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1	24EC748	Mini Project	0/0/2	2	1	P W
2	24EC861	Industrial Practices	0/0/0	0	2	IP
3	24EC781	Project Work	0/0/24	24	12	P W

MANDATORY COURSES (Non Credit)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1	24MC901	Mandatory Course I Induction program	2/0/0	2	0	MC
2	24MC902	Mandatory Course II Heritage of Tamils	2/0/0	2	0	MC
3	24MC903	Mandatory Course III Environmental Science and Sustainability	2/0/0	2	0	MC
4	24MC904	Mandatory Course IV Introduction to Women and Gender Studies	2/0/0	2	0	MC

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24MA211	Matrices And Calculus	BS	3	1	0	4
Course Outcomes (s)						
Upon completion of the course, students shall have ability to						RBT
CO1	Utilize matrix algebra techniques effectively to solve practical engineering problems.					AP
CO2	Apply differential calculus tools to solve a wide range of engineering application problems, effectively utilizing concepts such as derivatives and differential equations to model and analyze real-world phenomena.					AP
CO3	Apply differential calculus concepts to functions of several variables, enabling them to analyze complex relationships and phenomena encountered in engineering contexts.					AP
CO4	Employ a variety of integration methods, empowering them to solve practical engineering problems efficiently and accurately.					AP
CO5	Apply the principles of multiple integrals to address a variety of practical engineering challenges, effectively solving problems related to areas, volumes, and other pertinent applications.					AP

Course Content		
Unit – I	MATRICES	12
Eigen values and Eigen vectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigen vectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.		
Unit – II	DIFFERENTIAL CALCULUS	12
Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Maxima and Minima of functions of one variable.		
Unit – III	FUNCTIONS OF SEVERAL VARIABLES	12
Partial differentiation – Homogeneous functions and Euler’s theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor’s series for functions of two variables – Maxima and minima of functions of two variables and Lagrange’s method of undetermined multipliers.		
Unit – IV	INTEGRAL CALCULUS	12
Definite and Indefinite integrals - Substitution rule - Techniques of Integration : Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.		
Unit – V	MULTIPLE INTEGRALS	12
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.		
TOTAL : 60 Hours		
Learning Resources		
Textbooks		
1	Kreyszig. E, “Advanced Engineering Mathematics”, John Wiley and Sons, 10th Edition, New Delhi, 2016.	
2	Grewal.B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition, 2018.	
3	James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].	
Reference Books		
1	Anton. H, Bivens. I and Davis. S, "Calculus", Wiley, 10th Edition, 2016.	
2	Bali. N., Goyal. M. and Watkins. C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt. Ltd.), New Delhi, 7th Edition, 2009.	
3	Jain R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 5th Edition, 2016.	
4	Narayanan. S. and Manicavachagom Pillai. T. K., “Calculus” Volume I and II, S. Viswanathan Publishers Pvt. Ltd.,	

	Chennai, 2009.
5	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6	Srimantha Pal and Bhunia. S.C, "Engineering Mathematics" Oxford University Press, 2015.
7	Thomas. G. B., Hass. J and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.
Web References	
1	https://nptel.ac.in/courses/122104018/
2	https://archive.nptel.ac.in/courses/111/104/111104092
3	https://onlinecourses.nptel.ac.in/noc20_ma27/preview
4	https://archive.nptel.ac.in/courses/111/105/111105122
5	https://nptel.ac.in/courses/111105122

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24CS312	PROGRAMMING IN C	PC	3	0	0	3
Regulation		Nature of the Course	Semester	Data Book/Codes/Standards		
R24		Programming	I			
Pre-requisite Course (s)			Co-requisite Course(s)			
			PROGRAMMING IN C LABORATORY			
Course Objective (s)						
1	To understand the basics of algorithmic thinking and problem-solving.					
2	To develop knowledge in the C programming language, including syntax, data types, and operators					
3	To develop programs using control flow, functions, pointers.					
4	To understand the basics of file handling.					
5	To be able to design, write, and debug C programs to solve problems in various domains.					
Course Outcomes (s)						
Upon completion of the course, students shall have ability to						RBT
CO312.1	Understand programming using algorithms, flowcharts and pseudocode					U
CO312.2	Develop a C program using datatypes, control flow and arrays					AP
CO312.3	Implement decision-making using if-else, switch and control flow statements					AP
CO312.4	Apply functions and recursion to solve problems systematically					AP
CO312.5	Use pointers to implement the memory manipulation and allocation					AP
CO312.6	Create, read, write, and append data to files in C					AP
Course Contents						
Unit – I	ALGORITHMIC THINKING & INTRODUCTION TO C LANGUAGE					9
Algorithm -Definition, Characteristics of Algorithms. Constituents of algorithms: - Sequence, Selection and Repetition. Flowchart/Pseudocode with examples. Introduction To C Language: Structure of C Program, Data Types, Input and Output statements, Operators, Precedence and Associativity of operators, Evaluation of Expressions, Type Conversions in Expressions, Example programs for operator precedence and evaluating expressions.						
Unit – II	CONTROL STRUCTURES AND ARRAYS					9
Control structures: Decision statements; if and switch statement; Loop control statements: while, for and do while loops, Jump statements: break, continue, goto statements, Example programs using decision statements, looping statements and jump statements. Arrays: Concepts, One dimensional array, declaration and initialization of one dimensional arrays, two dimensional arrays, initialization and accessing, multi-dimensional arrays, programming examples using arrays						
Unit – III	FUNCTIONS AND POINTERS					9
Functions: Function definition, Types of Functions: User defined and built-in Functions, Advantages of User Defined Functions. Parameter passing in functions: Call by value, Call by reference, passing arrays to functions, Recursion as a different way of solving problems, example programs to perform call by value and reference, nested functions, recursion. Pointers: Pointer basics, pointer arithmetic, pointers to pointers, generic pointers, array of pointers, Functions returning pointers, Dynamic memory allocation, Example program to perform types of pointers.						
Unit – IV	STRINGS AND USER DEFINED DATA TYPES					9
Strings: Array of characters, variable length character strings, input character strings, character library functions, String Handling Functions, Arrays of Strings, Example programs to perform string length, copy, concatenate and compare. Structures and Unions: Structure definition, initialization, accessing structures, nested structures, arrays of structures, Structures and functions, Self-referential structures, unions, typedef						

enumerations, Difference between structure and union with examples.		
Unit – V	FILE HANDLING	9
File Handling: Command Line Arguments, File Modes, Basic File Operations Read, Write and Append, Example Programs. Random Access Using fseek, ftell and rewind Functions.		
Total Hours		45
Learning Resources		
Textbooks		
1	Computer Science: A Structured Programming Approach Using C, B.A.Forouzan and R.F.Gilberg, 2020.	
2	ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016.	
Reference Books		
1	The C Programming Language by Brian Kernighan and Dennis Ritchie 2nd edition.	
2	Computer Programming and Data Structures by E.Balagurusamy, Tata McGraw Hill, 2008.	
3	Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, 1st Edition, Pearson Education, 2013.	
Online Resources		
1	Introduction to programming in C - Course (nptel.ac.in)	
2	https://www.udemy.com/topic/c-programming/	

AssessmentMethods&Levels(basedonBlooms’ Taxonomy)					
Formativeassessmentbasedon CapstoneModel(Max.Marks:20)					
Course Outcome	Bloom’s Level	AssessmentComponent			Marks
C0312.1	Understand	ClassPresentation/Power point presentation			2
C0312.2	Apply	GroupAssignment&Tutorial			2
C0312.3	Apply	GroupAssignment&Tutorial			4
C0312.4	Apply	GroupAssignment&Tutorial			4
C0312.5	Apply	GroupAssignment&Tutorial			4
C0312.6	Apply	GroupAssignment&Tutorial			4
Summativeassessment basedonContinuousandEndSemester Examination					
Bloom’sLevel	ContinuousAssessment			End SemesterExamination (50Marks)	
	CIA1 (10Marks)	CIA2 (10Marks)	Model Exam (10Marks)		
Remember					
Understand	40%	20%	30%	30%	
Apply	60%	80%	70%	70%	
Analyze					
Evaluate					
Create					

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
C0312.1	√	√	√	√									√	√
C0312.2	√	√	√	√	√					√		√	√	√
C0312.3	√	√	√	√	√					√		√	√	√
C0312.4	√	√	√	√	√					√		√	√	√
C0312.5	√	√	√	√	√					√		√	√	√
C0312.6	√	√	√	√	√					√		√	√	√

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24BP213	PHYSICS FOR ELECTRONICS SCIENCES	BS	3	0	2	4
Course Outcome (s)						
Upon completion of the course, students shall have ability to						RBT
CO 1	Understand the basic principles of properties of matter and lasers with different types of lasers.					[U]
CO 2	Understand the principles of Newtonian Mechanics and apply it in engineering context and to solve numerical problems.					[U]
CO 3	Understand basic principles of Quantum mechanics and tunnelling microscope					[U]
CO 4	Illustrate merits of electron theory of materials and principle, types, properties and application of semiconductors					[U]
CO 5	Understand the foundational knowledge of nanoelectronic devices and advanced engineering materials.					[U]

Course Content		
Unit – I	PROPERTIES OF MATTER AND LASER	9
Elasticity- Hooke's law - stress - strain diagram and its uses- Poisson's ratio – Bending moment – Depression of a cantilever – Young's modulus by uniform bending- I-shaped girders. Laser – characteristics – Spontaneous and Stimulated emission- population – inversion - Metastable states - optical feedback - Nd-YAG laser, Semiconductor laser - Industrial and medical applications.		
Unit – II	MECHANICS	9
Multi particle dynamics: Centre of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M.I - torque –conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - Torsional pendulum.		
Unit – III	BASIC QUANTUM MECHANICS	9
Black body radiation-Planck's hypothesis, wave-particle duality, introduction to quantum theory, de-Broglie concept of matter waves-wave function - The Schrodinger equation (Time dependent and time independent forms) - Normalization of wave function– particle in a infinite potential well: 1D Box - Quantum tunnelling (qualitative) and Scanning Tunnelling microscope.		
Unit – IV	SEMICONDUCTING MATERIALS	9
Introduction-Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – band gap determination– compound semiconductors - direct and indirect band gap- derivation of carrier concentration in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration -- Hall effect –Determination of Hall coefficient –Application.		
Unit – V	NANOELECTRONIC DEVICES	9
Density of states for solids - Significance between Fermi energy and volume of the material – Quantum confinement – Quantum structures – Density of states for quantum wells, wires and dots – Band gap of nonmaterials –Tunnelling – Single electron phenomena – Single electron Transistor. Carbon nanotubes: Properties and applications – quantum well laser.		
Total Hours		45
Course Outcomes		
Upon completion of the course, students shall have ability to		
CO 6	Demonstrate the basic measurement techniques and the use of the basic concepts of elasticity, lasers, heat transfer, mechanics and semiconductor physics.	[AP]
Lab Components		
1. Determination of Young's modulus of the cantilever by Simple Harmonic Oscillations. 2. Uniform bending – Determination of Young's modulus of the beam. 3. Non-uniform bending - Determination of Young's modulus of the beam. 4. Laser- Determination of the wavelength of the laser source using grating. 5.Torsional pendulum - Determination of Rigidity modulus of wire and moment of inertia of regular and irregular objects. 6. Determine the wave length of prominent lines of mercury by plane diffraction grating with the help of spectrometer. 7. Determination of Dispersive power of a prism – Spectrometer. 8. Determination the Fermi Energy of a Metal by metre bridge. 9. Post office box -Determination of Band gap of a semiconductor. 10. Air wedge - Determination of thickness of a thin sheet/wire.		
Total Hours		30

Textbooks	
1	A Textbook of Engineering Physics, Gaur and Gupta, Dhanpat Rai Publishers, New Delhi, 8th edition, 2011.
2	D. Kleppner and R. Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
3	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.
Reference Books	
1	S.O. Pilai, Sivakami "Engineering Physics", IV Edition, New Age International Publishers, 2011.
2	M A Wahab, "Solid State Physics", 3 rd Edition, Narosa Publishing House Pvt. Ltd., 2015.
3	Kakani S.L "Nanotechnology", New Age International (P) Ltd., Publishers", 2020.
Web References	
1	https://phet.colorado.edu/en/simulations/forces-and-motion-basics
2	https://blossoms.mit.edu/resources/physics_resources
3	https://amrita.olabs.edu.in

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24HS114	Technical English	HS	2	0	2	3
Course Outcomes (s)						
Upon completion of the course, students shall have ability						RBT
CO 1	to precisely explain products and write instructions.					AP
CO 2	to effectively express their ideas both in writing and non-verbal.					AP
CO 3	to compose emails, formal letters, and descriptions/narratives.					AP
CO 4	to gain knowledge in writing essays on various topics.					AP
CO 5	to develop the writing skills specific reference to technical writing.					AP

Course Content		
Unit – I	DESCRIPTION OF A PROCESS / PRODUCT	6
Reading – Reading advertisements. Writing – instructions, Product /Process description. Grammar - Adjectives; Degrees of comparison; Present Tense.		
Unit – II	UNDERSTANDING AND IMPLEMENTING	6
Reading - Reading biographies, newspaper reports . Writing - Transferring information from non verbal. Grammar - Past tense, Subject-Verb Agreement Prepositions. Phrasal verbs.		
Unit – III	BASICS OF COMMUNICATION	6
Reading - Reading brochures. Writing - Writing emails / letters introducing oneself. Grammar - Question types: Wh/ Yes or No/ and Tags, One word substitution.		
Unit– IV	EXPRESSION OF OPINION	6
Reading – Reading editorials; and Opinion Blogs. Writing - Essay Writing. Grammar - Future Tenses, Punctuation; Negation (Statements & Questions)		
Unit – V	CLASSIFICATION AND RECOMMENDATIONS	6
Reading – Newspaper articles; Journal reports. Writing - Note-making / Note-taking, Writing recommendations. Grammar - Articles; Pronouns - Possessive & Relative pronouns.		
English Laboratory		
Upon completion of the course, students shall have ability to		
CO 6	Speak fluently and accurately in formal and informal communicative.	AP
1. Self Introduction. 2. Introducing a friend and others. 3. Narrating personal experiences. 4. Giving instruction to use the product Presenting a product. 5. Talking about precautions in different situation. 6. Talking about a given topic. 7. Making polite requests, making polite offers, replying to polite requests.		
		TOTAL: 60 Hours
Learning Resources		
Textbooks		
1	English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition).	
2	English for Science & Technology Cambridge University Press, 2021.	
3	Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.	
Reference Books		
1	A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt.Ltd.	
2	Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.	
Web References		
1	https://archive.nptel.ac.in/courses/109/106/109106094/	

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EP315	Engineering Practices Laboratory (Common to all department)	ES	0	0	4	2
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R2024	Practical	II	Nil			
Pre-requisite Course(s)		Co-requisite Course(s)				
NIL		NIL				
Course Objectives						
1	Able to draw pipeline plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in common household woodwork.					
2	To demonstrate various electrical wiring connections in common household.					
3	Able to do various welding joints in steel plates using arc welding work; Machining simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipment's; Making a tray out of metal sheet using sheet metal work.					
4	Ability to Solder, test and Desolder simple electronic components on PCB.					
5	Able to understand the working of basic household appliances, logic gates and basic laws.					
Course Outcomes						
Upon completion of the course, students shall have ability to						
C315.1	Draw pipeline plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in common household woodwork.					AP
C315.2	Demonstrate various electrical wiring connections in common household.					AP
C315.3	Do various welding joints in steel plates using arc welding work; Machining simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipment's; Making a tray out of metal sheet using sheet metal work.					AP
C315.4	To Solder, test and Desolder simple electronic components on PCB.					AP
C315.5	To understand the working of basic household appliances and logic gates and basic laws.					U
List of Experiments:						
GROUP A						
CIVIL ENGINEERING PRACTICES						
1	Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.					
2	Preparing plumbing line sketches					
3	Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.					
4	Sawing and Planning.					
5	Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.					
MECHANICAL ENGINEERING PRACTICES						
1	Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding					
2	Practicing gas welding					
3	Basic Machining work- turning, drilling and tapping					
4	Making of a square tray					
5	Demonstrating basic foundry operations.					
GROUP B						
ELECTRICAL ENGINEERING PRACTICE						
1	Residential house wiring using switches, fuse, indicator, lamp and energy meter and fuse calculation.					

2	Fluorescent Lamp wiring.
3	Two way switch connection.
4	Measurement of electrical quantities -Voltage, Current, Energy, Power& power factor in RLC circuit.
5	Measurement of resistance to earth of electrical equipment.
ELECTRONICS ENGINEERING PRACTICE	
1	Study of Electronic components and equipment – Resistor, colour coding measurement
2	Investigate sinusoidal, square, and triangular waveforms signal parameter measurement (peak-peak, RMS period, frequency) using DSO.
3	Study of logic gates AND, OR, EX-OR and NOT.
4	Verification of Ohm’s Law and Kirchhoff’s Laws.
5	Soldering and De-soldering practice of electronic components using general purpose PCB.
6	Implementation of Regulated Power Supply (RPS).
Total Hours	
60	
Textbooks:	
1	S Gowri & T Jeyapoovan, “Engineering Practices Lab Manual”, Fifth Edition, Vikas Publishing
2	D. Citharthan. “ENGINEERING PRACTICES LABORATORY (GROUP B)” February 2020

Assessment Methods & Levels (based on Blooms' Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	Rubric based Continuous Assessment [60 marks] (in %)	End Semester Examination [40 marks] (in %)
Remember		
Understand	20%	20%
Apply	80%	80%
Analyze		
Evaluate		
Create		

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
C315.1	√	√			√	√	√					√	√	√	√
C315.2	√	√			√	√	√					√	√	√	√
C315.3	√	√			√	√	√					√	√	√	√
C315.4	√	√			√	√	√					√	√	√	√
C315.5	√	√			√	√	√					√	√	√	√

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24CS316	PROGRAMMING IN C LABORATORY	PC	0	0	4	2
Regulation		Nature of the Course	Semester		Data Book/Codes/Standards	
R2024		Practical	I			
Pre-requisite Course (s)			Co-requisite Course(s)			
Course Objective (s)						
1	To design an algorithm using pseudocode and flowchart.					
2	To develop programs in C using basic constructs.					
3	To develop applications in C using arrays and functions.					
4	To develop applications in C using Strings and pointers.					
5	To develop applications in C using structures.					
6	To develop applications in C using file processing.					
Course Outcomes (s)						
Upon completion of the course, students shall have ability to						
C0316.1	Design an algorithm using pseudocode and flowchart.					AP
C0316.2	Develop C programs for simple applications making use of basic constructs.					AP
C0316.3	Develop C programs using arrays and strings.					AP
C0316.4	Develop C programs involving functions, recursion.					AP
C0316.5	Develop applications in C using pointers, and structures.					AP
C0316.6	Design applications in C using sequential and random access file processing					AP

List of Experiments:	
Exp. No.	Name of the Experiment
1	Design an algorithm using pseudocode and flowchart
2	I/O statements, operators, expressions
3	Decision-making constructs: if-else, goto, switch-case
4	Loops: for, while, do-while
5	Arrays: 1D and 2D, multi-dimensional arrays
6	Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7	Recursion
8	Pointers: Arrays, Pointers to Pointers, Array of Pointers

9	Strings: Operations	
10	Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.	
11	Files: reading and writing, File pointers, file operations, random access	
		Total Hours
		60
Learning Resources		
Reference Books		
1	Computer Science: A Structured Programming Approach Using C, B.A.Forouzan and R.F.Gilberg, Third Edition, 2006.	
2	ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016.	
3	The C Programming Language by Brian Kernighan and Dennis Ritchie 2nd edition.	
4	Computer Programming and Data Structures by E.Balagurusamy, Tata McGraw Hill, 2008.	
5	Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, 1st Edition, Pearson Education, 2013.	
Online Resources		
1	Introduction to programming in C - Course (nptel.ac.in)	
2	https://www.udemy.com/topic/c-programming/	

Assessment Methods & Levels (based on Blooms' Taxonomy)														
Summative assessment based on Continuous and End Semester Examination														
Bloom's Level	Rubric based Continuous Assessment [60 marks] (in %)									End Semester Examination [40 marks] (in %)				
Remember														
Understand														
Apply	100%									100%				
Analyze														
Evaluate														
Create														
COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
C0316.1	√	√	√	√					√				√	√
C0316.2	√	√	√	√	√				√	√		√	√	√
C0316.3	√	√	√	√	√				√	√		√	√	√

C0316.4	√	√	√	√	√				√	√		√	√	√
C0316.5	√	√	√	√	√				√	√		√	√	√
C0316.6	√	√	√	√	√				√	√		√	√	√

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24MC901	Induction Program	MC	-	-	-	-

Course Content

This is a mandatory 3 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

“Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have a broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.”

“One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character.”

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, make decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people

who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the underprivileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering / Technology / Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

References:

Guide to Induction program from AICTE

Duration: 3 weeks

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24MA221	Differential Equations and Complex Functions	BS	3	1	0	4
Course Outcomes (s)						
Upon completion of the course, students shall have ability to						RBT
CO1	Learn about differential equations, fundamental tools in engineering, used to describe various physical phenomena.					AP
CO2	Understand how to solve the given standard partial differential equations.					AP
CO3	Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems					AP
CO4	Understand standard techniques in complex variable theory, focusing on analytic functions and their mapping properties.					AP
CO5	Develop familiarity with complex integration and contour integration techniques for practical application in real-world integrals.					AP

Course Content		
Unit – I	ORDINARY DIFFERENTIAL EQUATIONS	12
Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy’s and Legendre’s linear equations – Simultaneous first order linear equations with constant coefficients.		
Unit – II	PARTIAL DIFFERENTIAL EQUATIONS	12
Formation of partial differential equations - Singular integrals -- Solutions of standard types of first order partial differential equations - Lagrange's linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non- homogeneous types.		
Unit – III	TRANSFORMS AND DIFFERENCE EQUATIONS	12
Z- transforms - Elementary properties - Inverse Z - transform (using partial fraction and residues) - Convolution theorem - Formation of difference equations - Solution of difference equations using Z - transform.		
Unit – IV	ANALYTIC FUNCTIONS	12
Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z+k$, kz , $1/z$, z^2 , ez and bilinear transformation.		
Unit – V	COMPLEX INTEGRATION	12
Complex integration – Statement and applications of Cauchy’s integral theorem and Cauchy’s integral formula – Taylor’s and Laurent’s series expansions – Singular points – Residues – Cauchy’s residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).		
TOTAL : 60 Hours		
Learning Resources		
Textbooks		
1	Grewal B.S., “Higher Engineering Mathematics”, 44thEdition, Khanna Publishers, New Delhi, 2018.	
2	Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India, 2018.	
3	Sastry, S.S, “Engineering Mathematics”, Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.	
Reference Books		
1	Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.	
2	Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2021.	
3	James. G., "Advanced Modern Engineering Mathematics", 4thEdition, Pearson Education, New Delhi, 2016.	

4	Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
6	Wylie. R.C. and Barrett. L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012
Web References	
1	https://archive.nptel.ac.in/courses/111/108/111108081/
2	https://archive.nptel.ac.in/courses/111/101/111101153/
3	https://archive.nptel.ac.in/courses/111/106/111106111/
4	https://nptel.ac.in/courses/111106084/
5	https://archive.nptel.ac.in/courses/111/103/111103070/

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EE322	Basic Electrical and Instrumentation Engineering	ES	3	0	0	3
Pre-requisite Course(s)		Co-requisite Course(s)				
-		24BP213 24EP315	Physics for Electronic Sciences Engineering Practices Laboratory			
Course Objectives						
1	Able to understand the Elementary concepts and laws of Electric and Electromagnetism.					
2	Able to understand the working principle of different AC machines and its applications.					
3	Able to understand the working principle of different DC machines and its applications.					
4	Able to introduce the functional elements and working of measuring instruments and basics of bridges.					
5	Able to understand the working of wave generators, spectrum analyzers and harmonic distortion analyzers.					
Course Outcomes						
Upon completion of the course, students shall have ability to						
C322.1	Understand the Elementary concepts and laws of Electric and Electromagnetism.					[AN]
C322.2	Understand the working principle of different AC machines and its applications.					[U]
C322.3	Understand the working principle of different DC machines and its applications.					[U]
C322.4	Explicate the construction, working principles of various measuring instruments.					[U]
C322.5	Understand the working of wave generators, spectrum analysers and harmonic distortion analysers.					[U]
Course Contents						
Unit – 1	ELEMENTARY CONCEPTS					9
International System of Units - Electric Potential and Current - Conductivity and Conductance – Power, Energy. Ohm's Law, Kirchhoff's Laws, Series and Parallel Circuits. Electromagnetic - Faraday's Laws of Electromagnetic Induction, Lenz's Law, Laws of Electromagnetic Forces. Dynamically Induced EMF (Generator or Motional EMF), Statically Induced EMF or Transformer EMF, Self-Inductance, Mutual Inductance. Hysteresis Loss, Eddy Current Loss.						
Unit – 2	A.C. MACHINES					9
Transformers: Construction, principle of working, E.M.F equations, voltage and current ratios, losses, definition of regulation and efficiency. Three phase transformers and autotransformer. Induction Motors: Types, Construction, principle of working of single-phase Induction motor – Applications.						
Unit – 3	DC MACHINES					9
Construction, principle of working and Characteristics of DC machine Motoring and Generator mode - Shunt and Series machines – Applications. Special Machines: Construction, principle of working – Universal motor – BrushLess DC Motor (BLDC) – Stepper motor – Applications						
Unit – 4	MEASUREMENTS AND INSTRUMENTATION					9
Functional elements of an instrument, Standards and calibration, basics of measuring instruments Moving Coil and Moving Iron meters (PMMC Mechanism - D'ARSONAL Galvanometer - DC Ammeters and voltmeters) Measurement of resistance, inductance and capacitance using dc and ac bridges - digital voltmeters – Multimeter - VSWR meter - Frequency meter						
Unit – 5	SIGNAL SOURCES AND ANALYSERS					9
Function generator and pulse generators, Oscilloscopes – DSO and MSO, Harmonic Distortion and spectrum Analysers, Digital Recorders and printers, 3D printing - Realization of signal sources and analyzers.						
Total Hours						45
Textbooks:						
1	C. L. Wadhwa “BASIC ELECTRICAL ENGINEERING” Fourth Edition, New Age International (P) Limited, Publishers, 2007.					
2	D.P. Kothari, I J. Nagrath, “Basic Electrical and Electronics Engineering” Second Edition, McGraw					

	Hill India. 2020.
3	A Course in Electrical and Electronic Measurements and Instrumentation, Sawhney A.K, Puneet Sawhney, Dhanpat Rai & Co., 2012
4	Digital Fundamentals, Floyd, T.L. and Jain, R. P., Pearson Education, 11th edition, 2015
5	Albert D Helfrich, Cooper. W.D , "Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, New Delhi, 2009.
Reference Books:	
1	James A .Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
2	Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019.
3	M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology', Prentice Hall India, New Delhi, 2009.
4	J.J. Carr, 'Elements of Electronic Instrumentation and Measurement', Pearson Education India, New Delhi, 2011.
Web References:	
1	NPTEL course on Fundamentals on Electrical Engineering: https://nptel.ac.in/courses/108/105/108105112/
2	NPTEL course on Basic Electrical Technology: https://archive.nptel.ac.in/courses/108/105/108105112/ Module – 9, 10, 11, 12
3	NPTEL course on Electrical Measurements and Electronic Instruments: https://archive.nptel.ac.in/courses/108/105/108105153/

Assessment Methods & Levels (based on Blooms’ Taxonomy)					
Formative assessment based on Capstone Model (Max. Marks:10)					
Course Outcome	Bloom’s Level	Assessment Component			Marks
C322.1	Understand	Classroom or Online Quiz			2
C322.2		Class Presentation/Power point presentation			2
C322.3, 4, 5		Assignment & Tutorial			6
Summative assessment based on Continuous and End Semester Examination					
Bloom’s Level	Continuous Assessment			End Semester Examination (60 Marks)	
	CIA1 (5 Marks)	CIA2 (5 Marks)	Model Exam (10 Marks)		
Remember	20%	20%	20%	20%	
Understand	60%	80%	60%	60%	
Apply					
Analyze	20%		40%	40%	
Evaluate					
Create					

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
C322.1	√				√										
C322.2	√				√										
C322.3	√						√								
C322.4	√					√	√								
C322.5	√					√	√								

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EE323	NETWORK THEORY	ES	3	0	0	3
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R2024	Theory	II	****			
Pre-requisite Course(s)		Co-requisite Course(s)				
24MA211 Matrices and Calculus 24BP213 Physics for Electronic Sciences		24EE322 Basic Electrical and Instrumentation Engineering 24EE327 Electric Circuits Laboratory				
CourseObjectives						
1	To learn the basic concepts and behaviour of DC.					
2	To understand various methods of circuit/ network analysis using network theorems					
3	To understand the transient and steady state response of the circuits subjected to DC excitations and AC with sinusoidal excitations.					
4	To learn the concept of coupling in circuits and topologies.					
5	To impart knowledge on two port networks.					
CourseOutcomes						
Uponcompletionofthecourse,studentsshallhaveabilityto						
C101.1	Infer the basics of circuit analysis and graph theory					[U]
C101.2	Apply suitable network theorems and analyze AC and DC circuits					[AP]
C101.3	Compute the transient response for any RC, RL and RLC circuits					[AP]
C101.4	Discuss the characteristics of AC steady state analysis and power analysis.					[U]
C101.5	Illustrate the parameters of the two port networks and the concepts of resonance, coupled circuits					[U]
CourseContents						
Unit – 1	BASIC OF CIRCUIT ANALYSIS & GRAPH THEORY					9
Fundamentals concepts of R, L and C elements-Energy Sources- Ohms Law, Kirchhoff ‘s Laws- Independent Sources-Resistors in Series and Parallel-voltage and current division-Graph Theory-Concept of Tree, Incident Matrix, Tie set Matrix, Cut Set Matrix-Nodal analysis, Mesh analysis.						
Unit – 2	NETWORK THEOREM AND DUALITY					9
Network theorems: Superposition – Reciprocity - Thevenin’s - Norton’s - Maximum Power Transfer – Compensation - Substitution - Tellegen's theorem- Delta – Wye Transformation- Source Transformation and Duality						
Unit – 3	DC TRANSIENT ANALYSIS					9
RL and RC Circuits: Source free circuit – Properties of Exponential Response and Step functions – Natural and Forced Response Driven RL and RC circuits – RLC Circuits: Source free damped and under damped parallel RLC circuit – Critical Damping – Source free series RLC-Complete Response and lossless Circuits.						
Unit – 4	AC STEADY STATE AND POWER ANALYSIS					9
Analysis of AC steady state circuits: Characteristics, Forced Response to Sinusoidal functions, Phasor Relationship to passive components – Impedance and admittance – Application of Network Theorems – Power Analysis: Instantaneous – Average and RMS- Power, Power factor and Energy.						
Unit – 5	TWO PORT NETWORKS AND COUPLED CIRCUITS					9
One port and Two port networks – Z parameters – Y parameters – h parameters – ABCD parameters – Symmetrical and Asymmetrical networks – Characteristic impedance. Series and parallel Resonance: frequency response, Quality factor and Bandwidth - Introduction to coupled circuits – Tuned circuits -Single tuned circuits.						
Total Hours						45
Textbooks:						
1	W.H. Hayt and I.E.Kemmerley, “Engineering Circuits Analysis”, McGraw Hill Education 8th edition, 2014.					

2	S.K.Bhattacharya and Manpreet Singh, "Network analysis and Synthesis", 1st edition, Pearson Publication, 2015
3	Alexander C. and Sadiku M. N. O., — "Fundamentals of Electric Circuits ", Tata McGraw Hill, New Delhi, 2013.
ReferenceBooks:	
1	Sudhakar A. and Shyammoan S. Pillai, — "Circuits and Networks Analysis and Synthesis", McGraw Hill, New Delhi, 2015
2	S.P.Ghosh and A K Chakraborty, "Network analysis and Synthesis", Tata McGraw Hill, New Delhi, 2014.
3	John. D. Ryder, "Networks Lines and Fields"- PHI 2nd edition, 2003..
Web References:	
1	https://nptel.ac.in/courses/108102042/
2	https://nptel.ac.in/courses/106105154/2
3	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/video-lectures/lecture-2/

AssessmentMethods&Levels(basedonBlooms' Taxonomy)					
Formativeassessmentbasedon CapstoneModel(Max.Marks:20)					
Course Outcome	Bloom's Level	AssessmentComponent			Marks
C101.1	Remember	Classroomor OnlineQuiz			4
C101.2	Understand	ClassPresentation/Power pointpresentation			6
C101.3,4,5	Apply	GroupAssignment&Tutorial			10
Summative assessment based on Continuous and End Semester Examination					
Bloom'sLevel	ContinuousAssessment			End Semester Examination (50Marks)	
	CIA1 (10Marks)	CIA2 (10Marks)	Model Exam (10Marks)		
Remember	10%	10%	10%	10%	
Understand	40%	30%	50%	50%	
Apply	50%	60%	40%	40%	
Analyze					
Evaluate					
Create					

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
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	
24HS124	Professional English	UC	2	0	2	3
Course Outcomes (s)						
Upon completion of the course, students shall have ability to						RBT
CO 1	Compose email effectively to convey ideas in appropriate tone.					AP
CO 2	Use the student's knowledge and experiences to comprehend technical texts.					AP
CO 3	Understand governing the way in which words are put together to convey meaning in different contexts.					AP
CO 4	Write effective resumes and cover letter to the context of job search.					AP
CO 5	Write checklists to organize thoughts and communicate in with written format.					AP

Course Content		
Unit – I	MAKING COMPARISONS	6
Reading - Company profiles. Writing – Professional emails, Email etiquette - Compare and Contrast Essay. Grammar – Mixed Tenses, Prepositional phrases. Compound Nouns, Vocabulary.		
Unit – II	PROBLEM SOLVING	6
Reading – Newspaper articles. Writing – Recommendations, Accident Report and Survey Report. Grammar – Reported Speech, Modals, Conjunctions- use of prepositions		
Unit – III	SPEAKING AND WRITING ABOUT CAUSAL COMMUNICATION	6
Reading - Reading longer technical texts. Writing - Writing responses to complaints, transferring information from non verbal. Grammar – Active voice and Passive Voice, Infinitive and Gerunds.		
Unit – IV	THE ABILITY TO EXPRESS INFORMATION	6
Reading - an excerpt of interview with professionals. Writing – Job / Internship application – Cover letter & Resume. Grammar – Numerical adjectives, Relative Clauses.		
Unit – V	REPORTING AND RESEARCH	6
Reading - news reports. Writing – Letter to the Editor, Checklists. Grammar – Error correction, If conditional sentences.		
English Laboratory		
Upon completion of the course, students shall have ability to		
CO 6	Speak effectively in various situation held in a formal/semi formal conversation.	AP
1. Introduction to classmates. 2. Narrating personal experiences. 3. Discussing experiences various situation. 4. Discussing locations in workplaces. 5. Stories narration. 6. Discussing news stories. 7. Discussing imaginary scenarios.		
		TOTAL: 60 Hours
Learning Resources		
Textbooks		
1	Technical Communication – Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.	
2	A Course Book on Technical English By Lakshmi Narayanan, Scitech Publications (India) Pvt. Ltd.	
3	Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.	
Reference Books		
1	Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.	
2	Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.	
Web References		
1	https://onlinecourses.nptel.ac.in/noc22_hs77	
2	https://onlinecourses.nptel.ac.in/noc22_hs05	

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EG315	ENGINEERING GRAPHICS	ES	1	0	4	3
Pre-requisite Course(s)		Co-requisite Course(s)				
NIL		NIL				
Course Objectives						
1	Master the principles and techniques of technical drawing, including orthographic projection, isometric projection, and dimensioning.					
2	Enhance visualization skills to translate 2D drawings into 3D representations and vice versa.					
3	Gain hands-on experience with Computer-Aided Design (CAD) software to create, modify, and analyze engineering drawings digitally.					
4	Grasp geometric constructions and transformations to create accurate and precise engineering drawings.					
5	Develop problem-solving abilities by applying engineering graphics principles to solve real-world design and manufacturing challenges.					
Course Outcomes						
Upon completion of the course, students shall have ability to						
C315.1	Interpret and sketch the basic and intermediate geometries.					[AP]
C315.2	Create geometric constructions; drawing parallel and perpendicular lines, and to construct circles, arcs, tangencies, and irregular curves					[AP]
C315.3	Solve practical problems related to the projection of lines.					[AP]
C315.4	Prepare an orthographic and sectional orthographic views of any given object and comprehend the drawings to extract complete information of the object					[AP]
C315.5	Construct an isometric view and isometric projection of any object from provided orthographic views.					[AP]
Course Contents						
Unit – 1	Introduction to Computer Aided Sketching: Orthographic Projection of Points and Lines.					3
Introduction, Drawing Instruments and their uses, relevant BIS conventions and standards. Lettering, line conventions, dimensioning, material conventions, and free hand practicing. Computer screen, layout of the software, standard tool bar / menu and description of most commonly used tool bars, and navigational tools. Co-ordinate system and reference planes HP, VP, RPP & LPP of 2D/3D environment. Selection of drawing sheet size and scale. Commands and creation of Lines, coordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz., tangency, parallelism, inclination and perpendicularity. Orthographic Projection in First Angle only: Principles of Orthographic Projections – Conventions Projections of Points: Points in all four quadrants. Projections of Lines: Parallel and inclined to both plane.						
Unit – 2	Projections of Planes and Solids					3
Projections of Planes: Projection of regular planes, Plane inclined to both reference planes (No conditional problems). Projections of Solids: Projections of regular solids prism and pyramid inclined to both planes (No conditional problems).						
Unit – 3	Section of Solids					3
Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section.						
Unit – 4	Development of Lateral Surfaces of Solids					3
Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.						
Unit – 5	Isometric Projection					3
Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.						
Total Hours						15

Lab Components			
S.No	List of Experiments	COs	RBT
1	Orthographic Projection in First Angle only.	C315.1	AP
2	Projections of Points	C315.1	AP
3	Projections of Lines:	C315.1	AP
4	Projections of Planes: Projection of regular planes, Plane inclined to both reference planes	C315.2	AP
5	Projections of Solids: Projections of regular solids prism and pyramid inclined to both planes	C315.2	AP
6	Section of Solids: Solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other	C315.3	AP
7	Development of Lateral Surfaces of Solids: Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.	C315.4	AP
8	Isometric Projection:- isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.	C315.5	AP
Total Hours			60
Textbooks:			
1	K. V. Natrajan, “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai (2006).		
2	M.S. Kumar, “Engineering Graphics”, D.D. Publications, (2007).		
Reference Books:			
1	K. R. Gopalakrishnana, “Engineering Drawing” (Vol.I&II), Subhas Publications (1998).		
2	Dhananjay A.Jolhe, “Engineering Drawing with an introduction to AutoCAD” Tata		
3	McGraw Hill Publishing Company Limited (2008).		
4	Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill		
5	Publishing Company Limited, New Delhi, (2008).		
6	K. V. Natrajan, “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai (2006).		

Assessment Methods & Levels (based on Blooms' Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	Rubric based Continuous Assessment [60 marks] (in %)	End Semester Examination [40 marks] (in %)
Remember		
Understand		
Apply	100%	100%
Analyze		
Evaluate		
Create		

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2
C101.1	√	√	√		√					√		√		
C101.2	√	√	√		√					√		√		
C101.3	√	√	√		√					√		√		
C101.4	√	√	√		√					√		√		
C101.5	√	√	√		√					√		√		

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24BC226	CHEMISTRY FOR ELECTRONIC SCIENCES	PC	3	0	2	4
Course Outcomes (s)						
Upon completion of the course, students shall have ability to						RBT
CO1	Infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.					U
CO2	Recognize and understand the importance of electrochemistry and principles behind electrochemical cell, reference electrodes and glass electrodes.					U
CO3	Understand and identify appropriate corrosion protection techniques for addressing practical problems.					U
CO4	Understand various storage devices and identify their appropriate applications in the energy sector.					U
CO5	Understand different types of polymeric materials, their general preparation methods, and their applications to meet future material fabrication needs.					U

Course Content		
Unit – I	WATER TECHNOLOGY	9
Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, fluoride, TDS, COD, BOD and turbidity. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, calgon and carbonate treatment. External conditioning – demineralization and zeolite process. Municipal water treatment (screening, sedimentation, coagulation, filtration and disinfection-ozonation, UV treatment, chlorination), Desalination of brackish water: Reverse Osmosis.		
Unit – II	ELECTRO CHEMISTRY	9
Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – Single electrode potential – Nernst equation (problem) – reference electrodes –Standard Hydrogen electrode -Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – electrochemical series – significance – Potentiometer titrations (redox – Fe^{2+} vs dichromate and precipitation – Ag^+ vs Cl^- titrations) and Conductometric titrations (acid-base – HCl vs, NaOH) titrations.		
Unit – III	CORROSION SCIENCE	9
Introduction to corrosion - chemical and electrochemical corrosions-mechanism of electrochemical and galvanic corrosions-concentration cell corrosion-passivity-soil, pitting, inter-granular, water line, stress and microbiological corrosions-galvanic series-factors influencing corrosion- measurement of corrosion rate. Corrosion control-material selection and design-electrochemical protection- sacrificial anodic protection and impressed current cathodic protection. Protective coatings- organic coatings (paints). Paints: Constituents and functions. Metallic coatings – electroplating (Au) and electroless (Ni) plating.		
Unit – IV	ENERGY SOURCES	9
Batteries - Characteristics - types of batteries – primary battery (dry cell, Alkaline battery), secondary battery (lead acid, lithium-ion-battery) – Fuel cells (Types) – H_2 - O_2 fuel cell – microbial fuel cell- Super capacitors- Types and Applications, Renewable Energy: Solar- solar cells.		
Unit – V	POLYMER CHEMISTRY	9
Introduction: Functionality-degree of polymerization. Types of polymerization, Mechanism of free radical addition polymerization. Properties of polymers: T_g , tacticity, molecular weight-number average, weight average, viscosity average and polydispersity index (Problems). Techniques of polymerization: Bulk, emulsion, solution and suspension. Engineering Plastics: PVC, Polyamides, Polycarbonates, Polyester and Polyurethanes. Compounding and Fabrication Techniques: Injection, Extrusion, Blow and Calendaring		
		TOTAL: 45 Hours
Lab Components		
Course Outcomes		
Upon completion of the course, students shall have ability to		
CO6	Analyze and interpret experimental data from various chemical estimation methods, nanoparticle preparation techniques, and corrosion evaluation to address practical challenges in engineering and technology applications.	AN
LIST OF EXPERIMENT'S (Any seven experiments to be conducted) 1. Estimation of HCl using Na_2CO_3 as primary standard 2. Determination of hardness of water by EDTA method. 3. Determination of alkalinity in water sample. 4. Determination of chloride content of water sample by Argentometric method.		

5. Determination of strength of given hydrochloric acid using pH meter. 6. Preparation of nanoparticles (TiO ₂ /ZnO/CuO) by Sol-Gel method. 7. Corrosion experiment-weight loss method. 8. Estimation of iron content of the given solution using potentiometer 9. Conductometric titration of barium chloride against sodium sulphate (precipitation titration) 10. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.	
Total Hours	
30	
Learning Resources	
Textbooks	
1	Jain P. C. & Monica Jain., "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2	Dara S.S., "A Text book of Engineering Chemistry", Chand Publications, 2004
Reference Books	
1	Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
2	Friedrich Emich, "Engineering Chemistry", Medtech, 2014.
3	Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, "Polymer Science" New AGE International Publishers, 2009.
Web References	
1	https://learncheme.com/
2	https://www.coursera.org/browse/physical-science-and-engineering/chemistry
3	http://www.cheresources.com/

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
ACADEMIC YEAR – 2024-2025

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EE327	Electric Circuits Laboratory	ES	0	0	4	2
Regulation		Nature of the Course	Semester	Data Book/Codes/Standards		
R2024		Practical	II	****		
Pre-requisite Course (s)			Co-requisite Course(s)			
Nil			Nil			
Course Objective (s)						
1	To simulate various electric circuits using Pspice/ Matlab/e-Sim / Scilab					
2	To gain practical experience on electric circuits and verification of theorems					
3	To gain practical experience on two port networks					
Course Outcomes (s)						
Upon completion of the course, students shall have ability to						RBT
C0327.1	Use simulation and experimental methods to verify the fundamental electrical laws and the various electrical theorems for the given DC/AC circuit					AP
C0327.2	Compute transient behaviour of the given RL/RC/RLC circuit using simulation and experimental methods					AP
C0327.3	Determine frequency response of the given series and parallel RLC circuit using simulation and experimentation methods					AP
C0327.4	Analyze the performance of the given three-phase circuit using simulation and experimental methods					AN
C0327.5	Calculate various two port parameters of circuits using simulation method.					AP

Course Content			
List of Experiments:		COs	RBT
1	Experimental verification of series and parallel electrical circuit using fundamental laws.	1	AP
2	Experimental verification of electrical circuit problems using Nodal Analysis	1	AP
3	Experimental verification of electrical circuit problems using Mesh Analysis	1	AP
4	Experimental verification of electrical circuit problems using Thevenin's theorem.	1	AP
5	Experimental verification of electrical circuit problems using Norton's theorem.	1	AP
6	Experimental verification of electrical circuit problems using Superposition theorem.	1	AP
7	Experimental verification of Maximum Power transfer theorem	1	AP
8	Design and implementation of series and parallel resonance circuit.		AP
9	Simulation and Experimental validation of R-C,R-L and RLC electric circuit transients	2	AP
10	Simulation and Experimental validation of frequency response of RLC electric circuit.	3	AP
11	Simulation and experimental verification of three phase balanced and unbalanced star, delta networks circuit (Power and Power factor calculations).	4	AN
12	Determine the Impedance (Z) and admittance (Y) parameters of a two-port network using simulation methods	5	AP
13	Determine the Transmission (ABCD) and Hybrid parameters of a two-port network using simulation methods	5	AP
		Total	60
Textbooks:			
1	W.H. Hayt and I.E.Kemmerley, "Engineering Circuits Analysis", McGraw Hill Education 8th edition, 2014.		
2	S.K.Bhattacharya and Manpteet Singh, "Network analysis and Synthesis", 1st edition, Pearson Publication,2015		
3	Alexander C. and Sadiku M. N. O., – "Fundamentals of Electric Circuits ", Tata McGraw Hill, New Delhi, 2013.		
Reference Books:			

1	S.P.Ghosh and A K Chakraborty, "Network analysis and Synthesis", Tata McGraw Hill, New Delhi, 2014.	
Web References:		
1	https://nptel.ac.in/courses/108102042/	
2	https://nptel.ac.in/courses/106105154/2	
3	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/video-lectures/lecture-2/	

Bloom's Taxonomy based Assessment Methods and Levels		
Bloom's Level	ContinuousAssessment [60 Marks]	Autonomous Examination [40 Marks]
Remember		
Understand		
Apply	40%	60%
Analyze	60%	40%
Evaluate		
Create		

COs/ POs	P O 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
C0327.1		√							√	√					√
C0327.2		√			√				√	√					√
C0327.3		√			√				√	√					√
C0327.4		√			√				√	√					√
C0327.5		√							√	√					√

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24MC902	Heritage of Tamils	PC	2	0	0	0
Course Outcomes (s)						
Upon completion of the course, students shall have ability to						RBT
CO1	Learn about heritage of tamils and dravidian language					U
CO2	Know about sculpture and arts					U
CO3	Understand about folk and martial arts of our state					U
CO4	Learn about thinai literature concept to compare with life					U
CO5	Learn about the freedom fighters of Tamil Nadu in historical and Indian movements					U

Course Content		
Unit – I	LANGUAGE AND LITERATURE / மொழி மற்றும் இலக்கியம்	3
Language families in india- Dravidian languages- Tamil a classical language- The Non-sectraian nature of sangam literature- The virtue of sharing sangam literature-Tamil epics-Ainjurukappiyangal- sittrilakiyangal-Development of modern literature in tamil. இந்திய மொழிக் குடும்பங்கள்- திராவிட மொழிகள்- தமிழ் ஒரு செம்மொழி- ஆழ்வார்கள்- நாயன்மார்கள்- திருக்குறளில் மேலாண்மைக் கருத்துக்கள்- தமிழகத்தில் சமண, பௌத்த சமயங்களின் தாக்கம்- பக்தி இலக்கியம்- தமிழ்க் காப்பியங்கள்- தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி- தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.		
Unit – II	HERITAGE-ROCK ART PAINTING TO MODERN ART – SCULPTURE / மரபு- பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை- சிற்பக் கலை	3
Mesolithic to modern sculpture- Impon idols- Tribals and their handicrafts-The art of chariot making –Terracotta- Folk deities-Thiruvalluvar statue at kumarimunai- Musical instruments-Role of temples in the socio-economic life of tamilians நடுகல் முதல் நவீன சிற்பங்கள் வரை- ஐம்பொன் சிலைகள்- பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள்- பொம்மைகள்- தேர் செய்யும் கலை- சுடுமண் சிற்பங்கள்- நாட்டுப்புறத் தெய்வங்கள்- குமரிமுனையில் திருவள்ளுவர் சிலை- இசைக் கருவிகள்- தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.		
Unit – III	FOLK AND MARTIAL ARTS / நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்	3
Meaning of therukoothu- karagattam- villupattu- Kaniyan koothu- Oyilattam- Tholpavai koothu- silambattam- valari-puliyattam-Games of tamilians. தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம்- தமிழர்களின் விளையாட்டுகள்.		
Unit – IV	THINAI CONCEPT OF TAMILS / தமிழர்களின் திணைக்கோட்பாடுகள்	3
Flora and fauna of tamilnadu-Agam and puram theories in tholkappiyam and sangam literature- Arakotpadu cherished by tamilians- Education in Tamilnadu during sangam literature-cities and ports during sangam period –Exports and imports – overseas conquest of cholas . தமிழகத்தின் தாவரங்களும், விலங்குகளும்,- தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள்- தமிழர்கள் போற்றிய அறக்கோட்பாடுகள்- சங்ககாலத்தில் எழுத்தறிவும், கல்வியும்- சங்ககாலத்தில் நகரங்கள், துறைமுகங்கள் மற்றும் ஏற்றுமதி, இறக்குமதி- கடல்கடந்த சோழர்களின் வெற்றி.		
Unit – V	CONTRIBUTION TO TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE / இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3
Role of tamilians in the Indian independence war-Influence of tamil culture in other parts of india- Self-respect movement- The role of siddha medicine in india- inscription and manuscripts- print history of tamilnadu		

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு- இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம்- சுயமரியாதை இயக்கம்- சித்த மருத்துவத்தின் பங்கு- கல்வெட்டுகள்- கையெழுத்துப்படிகள்- தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.	
TOTAL : 15 Hours	
Learning Resources	
Textbooks	
1	Heritage of tamils authored by S.Priyadharshini, VK Publications (2023 edition). “தமிழர் மரபு”- S.பிரியதர்ஷினி , VK Publications (2023 edition).
2	Heritage of tamils authored by K.Jayanthi ravikrishnan, Sri Krishna Hi-tech publishing company Pvt.Ltd (2023 edition) “தமிழர் மரபு”- K.ஜெயந்தி ரவிகிருஷ்ணன், Sri Krishna Hi-tech publishing company Pvt.Ltd (2023 edition)
Reference Books	
1	Social of life of the tamils(Dr.K.K.Pillay)-A joint publication of TNTB& ESC and RMRL. தமிழக வரலாறு- மக்களும் பண்பாடும்- கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2	Journey of Civilization Indus to vaigai (R.Balakrishnan) Published by:-RMRL கீழடி- வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்(தொல்லியல் துறை வெளியீடு)
3	Studies in the history of india with special reference to tamilnadu(Dr.K.K.Pillay) இந்திய வரலாறு- தமிழ்நாட்டின் முக்கியமானத் தகவல்களுடன்- (முனைவர் கே.கே.பிள்ளை)
Web References	
1	https://www.tamildigitallibrary.in



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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24MA233	Linear Algebra and Transforms Techniques	BS	3	1	0	4
Course Outcomes						
Upon completion of the course, students shall have ability to						
C233.1	Understand the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.					[AP]
C233.2	Demonstrate accurate and efficient use of advanced algebraic techniques					[AP]
C233.3	Apply Fourier series techniques to solve engineering problems.					[AP]
C233.4	Apply Fourier transform techniques to solve mathematical and engineering problems.					[AP]
C233.5	Apply Laplace transform techniques to solve differential equations and related engineering problems.					[AP]
Course Contents						
Unit – 1	Vector Spaces:					12
Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions						
Unit – 2	Linear Transformation and Inner Product Spaces :					12
Linear transformation -Null spaces and ranges -Dimension theorem -Matrix representation of a linear transformations -Inner product -Norms -Gram Schmidt orthogonalization process -Adjoint of linear operations -Least square approximation.						
Unit – 3	Fourier Series:					12
Dirichlet's conditions - General Fourier series - Odd and even functions - Half range sine series - Half range cosine series - Complex form of Fourier series - Parseval's identity - Harmonic analysis						
Unit – 4	Fourier Transforms:					12
Statement of Fourier integral theorem - Fourier transform pair - Fourier sine and cosine transforms - Properties - Transforms of simple functions - Convolution theorem - Parseval's identity.						
Unit – 5	Laplace Transform:					12
Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform -Statement of Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.						
Total Hours						60
Textbooks:						
1	S. H. Friedberg, A. J. Insel, and L. E. Spence, Linear Algebra, 5th ed. New Delhi: Pearson Education, 2019.					
2	B. S. Grewal, Higher Engineering Mathematics, 44th ed. New Delhi: Khanna Publishers, 2018					
3	G. James, Advanced Modern Engineering Mathematics, 4th ed. New Delhi: Pearson Education, 2016.					
ReferenceBooks:						
1	S. Kumaresan, Linear Algebra: A Geometric Approach, 2nd ed. New Delhi: PHI Learning Pvt. Ltd., 2017.					
2	Kolman. B. Hill. D.R., “Introductory Linear Algebra”, Pearson Education, New Delhi, First Reprint, 2009.					
3	G. Strang, Linear Algebra and Its Applications, 5th ed. New Delhi: Pearson Education, 2016.					
4	B. V. Ramana, Higher Engineering Mathematics, New Delhi: McGraw Hill Education Pvt. Ltd., 2018.					
5	C. R. Wylie and L. C. Barrett, Advanced Engineering Mathematics, 6th ed. New Delhi: Tata McGraw-Hill Education Pvt. Ltd., 2012.					
6	N. P. Bali and M. Goyal, A Textbook of Engineering Mathematics, 10th ed. New Delhi: Laxmi Publications Pvt. Ltd., 2021.					



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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EE332	ELECTROMAGNETIC FIELDS AND WAVES	Theory	3	1	0	4
Course Outcomes						
Upon completion of the course, students shall have ability to						
E332.1	(Understand) the basic principles and laws governing electromagnetism.					[U]
E332.2	(Analyze) the properties of materials affect the field potentials due to static charges and static electric fields.					[AN]
E332.3	(Analyze) the properties of materials affect the field potentials due to static charges and static magnetic fields.					[AN]
E332.4	(Apply) time-varying electromagnetic fields to study dynamic electric and magnetic behaviours like wave propagation and AC phenomena.					[AP]
E332.5	(Understand) Electromagnetic Wave Propagation and Electromagnetic Interference and Compatibility					[U]
Course Contents						
Unit – 1	INTRODUCTION TO ESSENTIAL MATHEMATICS FOR ELECTROMAGNETICSM					9
Rectangular, cylindrical and spherical coordinate systems, Overview of vector algebra, Integrals Containing Vector Functions, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Electromagnetic model, SI Units and constants, Null identities, Helmholtz's theorem.						
Unit – 2	TIME INDEPENDENT ELECTROSTATICS					9
Coulomb's law, Electric field, Electric flux density and dielectric constant, Gauss's law and applications, Electric potential, Conductors in static electric field, Dielectrics in static electric field, Boundary conditions, Capacitance, Poisson's and Laplace's equations, Electrostatic energy.						
Unit – 3	TIME INDEPENDENT MAGNETOSTATICS					9
Biot-Savart law and applications, Magnetic field intensity, Ampere's law, Magnetic flux density and idea of relative permeability, Vector magnetic potential, Boundary conditions for Magnetostatic fields, Lorentz force equation, Magnetic forces and torques, Inductance, Magnetic energy.						
Unit – 4	TIME DEPENDENT ELECTROMAGNETICS					9
Current density and Ohm's law, Equation of continuity, Maxwell's equations, Faraday's law, Conduction and Displacement currents, Electromagnetic boundary conditions, Time-harmonic fields.						
Unit – 5	INTRODUCTION TO ELECTROMAGNETIC WAVES AND COMPATIBILITY					9
Electromagnetic wave physical structure, Wave equations and solutions, Wave parameters -Velocity, Intrinsic impedance, Propagation constant - Skin depth - General Wave behaviours along uniform Guiding structures. Introduction to Electromagnetic Interference and Electromagnetic Compatibility, Sources and Victims of EMI, Radiation hazards to humans.						
Total Hours						45
Textbooks:						
1	W.H. Hayt Jr., J.A. Buck and M.Jaleel Akhtar, "Engineering Electromagnetics", 9th ed., McGraw-Hill (India), 2020					
2	Clayton R. Paul, "Introduction to Electromagnetic Compatibility", Wiley-Interscience, 2006					
Reference Books:						
1	David J. Griffiths, "Introduction to Electrodynamics", 4th ed., South Asia Edition, Cambridge University Press, 2020					
2	M.N.O. Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", 6th ed., Oxford (Asian Edition), 2015					
3	S. Ramo, Whinnery J R, "Fields and Waves in Communication Electronics", John Wiley, 2011					
4	Branislav M. Notaros, "Electromagnetics", 1sted.Pearson, 2011					
5	David K. Cheng, "Field and Wave Electromagnetics", 2nd ed., Pearson Education India,					

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC433	Electronic Devices and Circuits	PC	3	0	0	3
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R24	Theory	III	-----			
Course Objectives						
1	To give a comprehensive exposure to all types of devices and circuits constructed with discrete components					
2	To analyze the frequency response of small stage and tuned signal amplifiers					
3	To study about power amplifiers					
Course Outcomes						
Upon completion of the course, students shall have ability to						
C433.1	Apply the working principle of semiconductor diode for designing various diode applications					[AP]
C433.2	Explain about construction and working principle of transistors					[U]
C433.3	Classify the performance of different biasing types used for transistor operation.					[U]
C433.4	Apply the h parameters and small signal model for different transistor configuration					[AP]
C433.5	Illustrate the various types of tuned and power amplifiers.					[U]
Course Contents						
Unit – 1	SEMICONDUCTOR DIODES AND APPLICATIONS					9
Review of Semiconductor Basics - PN junction diode, Zener diode, –structure, operation and V-I characteristics, Small signal and Large signal models of PN junction diode-AC equivalent circuit-diffusion and transition capacitance, Break down Mechanisms-Rectification –Full-wave and Bridge –Capacitor Filters-Clipper and clamper , Voltage Multiplier Circuits - Tunnel Diode and Varactor Diode						
Unit – 2	BIPOLAR JUNCTION TRANSISTOR :					9
Introduction–Construction and Working principle of BJT-Transistor characteristics-CB, CE, CC -Thermal runaway, thermal stability, DC Biasing-: Operating point-Fixed -Emitter-Stabilized-Voltage-Divider bias Configuration- Compensation techniques,						
Unit – 3	FIELD EFFECT TRANSISTOR :					9
Field Effect Transistors -Construction and characteristics of JFET -MOSFET - Enhancement and Depletion Modes - Regions of Operation – MOSFET Characteristics - Biasing Method for MOSFET - MOSFET as a switch.						
Unit – 4	SINGLE STAGE AMPLIFIERS					9
Amplification in AC Domain- The Hybrid Equivalent model-Approximate Hybrid equivalent circuit-calculation of input and output impedance, voltage gain : CE, CC and CB configurations, Small signal analysis of MOSFET-Source follower, common source and common gate amplifier- Effect of the coupling capacitors and the internal capacitances of the transistors						
Unit – 5	TUNED AMPLIFIERS AND POWER AMPLIFIERS					9
Tuned Amplifier - Analysis of single tuned and stagger tuned amplifiers -Power amplifiers: Class A power amplifier, Class B amplifier operation, Transformer coupled Push pull circuits, Complimentary symmetry circuits, Class C power amplifier.						
Total Hours						45
Textbooks:						
1	Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 11th Edition, Pearson Education / PHI, 2015.					
2	David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5 th Edition, 2010.					
Reference Books:						
1	Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3 rd Edition, 2010.					
2	D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3 rd Edition, 1989					

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC434	Digital Logic Circuit Design	PC	3	0	2	4
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R24	Theory and Logical Design	III	-----			
Course Objectives						
1	To present the fundamentals of digital circuits and simplification methods.					
2	To practice the design of various combinational digital circuits using logic gates					
3	To bring out the analysis and design procedures for synchronous and asynchronous Sequential circuits					
4	To introduce semiconductor memories and related technology					
5	To introduce VLSI Design flow technology					
Course Outcomes						
Upon completion of the course, students shall have ability to						
C434.1	Manipulate various number systems, Boolean algebra and basic logic gates for given constraints					[U]
C434.2	Model simple combinational digital circuits using logic gates					[AP]
C434.3	Choose appropriate flip-flop based on the given conditions to construct synchronous sequential circuits and understand the usage of Memory in Digital Circuits					[AP]
C434.4	Build logic gates and use programmable devices					[AP]
C434.5	Use HDL & appropriate EDA tools for digital logic design and simulation					[AP]
Course Contents						
Unit – 1	Fundamental of Digital Electronics					9
Number Systems-Review of Boolean algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Simplification of Boolean Functions using Karnaugh Map up to 5 variables, Binary codes, Code Conversion.						
Unit – 2	Combinational Logic Design					9
Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Encoder, Decoder, Multiplexers , Comparators, Multiplexed Display, Barrel shifter and ALU						
Unit – 3	Sequential Logic Design					9
Flip flop: S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation						
Unit – 4	Logic Families and Semiconductor Memories					9
Digital Logic gates and its electrical characteristics- Specifications: Noise margin, Propagation delay, fan-in, fan-out, RTL,DTL,TTL,ECL,CMOS Logic families - Memory elements, Concept of Programmable logic devices . Logic Implementation using Programmable Devices.						
Unit – 5	Digital Design using Verilog HDL					9
Introduction to Verilog HDL-Verilog Language Fundamentals: Modules, ports, and port connections, Data types: nets, registers, vectors, Operators: arithmetic, logical, relational, bitwise, Basic syntax and conventions-Modeling Techniques in Verilog-Design of Digital Circuits: Combinational circuits: MUX, DEMUX, Encoder, Decoder, Sequential circuits: Flip-Flops (D, JK), Counters, Shift Registers, Simple FSM design (Moore/Mealy concept)-Test Benches and Simulation-Overview of Synthesis and FPGA						
Total Hours						45
Lab Components						
List of Experiments:						CO
1.	Verification of NAND, NOR, Ex-OR,AND& OR Gates.					CO1
2.	Implementation of half Adder & Full Adder					CO2
3.	Implementation of half Subtractor & Full Subtractor.					CO2
4.	Implementation of Demultiplexer / Decoder operation using IC-74138.					CO2
5.	Implementation of Seven segment display.					CO2
6.	Implementation of Binary to gray converter.					CO2

7.	Implementation of Arithmetic algorithms.	C02
8.	Implementation of various flip-flops.	C03
9.	Implementation of Counters.	C03
10	Implementation of shift register.	C03
	Total Hours: 30	
Textbooks:		
1	Moris Mano, —Digital Logic and Computer Design, PHI Publications, 2002	
2	Fundamentals of Digital Logic with Verilog Design, Stephen Brown and Zvonko Vranesic, 6th Edition, McGraw Hill publication, ISBN: 978-0-07-338054-4, 2014.	
ReferenceBooks:		
1	Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.	
2	R.L. Tokheim, —Digital Electronics, Principles and Applications, Tata McGraw Hill, 1999.	
3	S. Salivahanan & S. Ariviyhan. —Digital circuits and design, Vikas Publication, 2001	
Online links for study & reference materials		
1	https://nptel.ac.in/courses/117/106/117106086/	

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC435	Signals and Systems	PC	3	0	2	4
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R24	Analytical	III	-----			
Course Objectives						
1	To understand the basic properties of signal & systems					
2	To know the methods of characterization of LTI systems in time domain					
3	To analyze continuous time signals and system in the Fourier and Laplace domain					
4	To analyze discrete time signals and system in the Fourier and Z transform domain					
Course Outcomes						
Upon completion of the course, students shall have ability to						
C435.1	Understand the signal classification, manipulations and system classifications					[U]
C435.2	Analyze time and frequency domain components of continuous time signal					[U]
C435.3	Experiment time domain and frequency domain characteristics of continuous LTI systems					[AP]
C435.4	Analyze time and frequency domains components of discrete time signals					[AP]
C435.5	Experiment an LTI system's output in the frequency and time domains					[AP]
Course Contents						
Unit – 1	CLASSIFICATION OF SIGNALS AND SYSTEMS					9
Standard signals — Step, Ramp, Pulse, Impulse, Exponential and Sinusoidal — Signal Manipulations — Classification of signals — Continuous Time/Discrete Time, Periodic/Aperiodic signals, Even/Odd, Energy/Power signals — Classification of systems— Continuous Time/Discrete Time, Linear/Nonlinear, Time-variant/Time-invariant, Causal/Non-causal, Stable /Unstable						
Unit – 2	ANALYSIS OF CONTINUOUS TIME SIGNALS					9
Fourier series approximation — Fourier Transform — Properties of Fourier Transform — Laplace Transforms — Properties of Laplace Transforms						
Unit – 3	LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS					9
Impulse response — Convolution Integrals— Differential Equation— Fourier and Laplace transforms in Analysis of CT systems — CT systems Realizations						
Unit – 4	ANALYSIS OF DISCRETE TIME SIGNALS					9
Sampling Process — Discrete Time Fourier Transform (DTFT) — Properties of DTFT — Z-Transform, Properties of Z-Transform						
Unit – 5	LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS					9
Impulse response — Convolution sum—Difference equations— Discrete Fourier Transform & Z-Transform Analysis of Discrete Time LTI systems—DT systems Realizations						
Total Hours						45
Lab Components :						
List of Experiments:						CO
MATLAB / EQUIVALENT SOFTWARE PACKAGE BASED IMPLEMENTATION						
1. Generation of CT and DT signals						CO1
2. Signaling Operations with Elementary signals						CO1
3.Linear and Circular convolutions						CO1
4. Auto correlation and Cross Correlation						CO1
5. Verification of Sampling Theorem						CO4
6. Frequency Analysis and spectrum verification using DFT						CO2
Total Hours						30
Textbooks:						
1	Oppenheim, Willsky and Hamid, “Signals and Systems”, 2nd Edition, Pearson Education, New Delhi, 2015					
2	Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd Edition, Wiley, 2002					
Reference Books:						
1	M. J. Roberts, “Signals and Systems Analysis using Transform methods and MATLAB”, McGraw- Hill Education, 2018					
2	John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.					

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24CS336	PROBLEM SOLVING AND PYTHON PROGRAMMING	ES	3	0	2	4
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R24	THEORY CUM PRACTICAL	III	-----			

Course Outcomes**Upon completion of the course, students shall have ability to**

C336.1	Understand computational thinking, algorithm development, iteration, and recursion in the context of problem-solving.	U
C336.2	Demonstrate Python syntax, data types, expressions, and debugging techniques using the interpreter.	AP
C336.3	Develop and implement python programs using control flow, functions, and string manipulations.	AP
C336.4	Implement advanced data structures and perform complex data processing using list comprehension.	AP
C336.5	Apply file I/O operations and use modules and packages to build modular and reusable python programs.	AP

Course Contents

Unit – 1	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9
Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation, simple strategies for developing algorithms (iteration, recursion).		
Unit – 2	DATA TYPES, EXPRESSIONS, STATEMENTS	9
Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments.		
Unit – 3	CONTROL FLOW, FUNCTIONS, STRINGS	9
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays.		
Unit – 4	LISTS, TUPLES, DICTIONARIES	9
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension.		
Unit – 5	FILES, MODULES, PACKAGES	9
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages.		
Total Hours		45
Lab Components		
List of Experiments		
1	Python programming using simple statements and expressions.	C01
2	Scientific problems using Conditionals and Iterative loops.	C01
3	Implement the python program for exchanging the values of two variables, circulate the values of n variables.	C02
4	Implement the python program for distance between two points.	C03
5	Implementing real-time/technical applications using Sets, Dictionaries.	C03
6	Implementing programs using Functions.	C03
7	Implementing programs using Strings.	C04
8	Implementing real-time/technical applications using File handling.	C04
9	Implementing real-time/technical applications using Exception handling.	C05
10	Implementing programs for word count, copy file, Voter's age validation, Marks range validation (0-100)	C05
11	Mini Project	C05
Total Hours		30

Textbooks:

1	Allen B. Downey. Think Python: How to Think Like a Computer Scientist. 3rd Edition. 3rd Edition - 2 July 2024. ISBN-13: 978-1098155438 ISBN-10: 1098155432. 4.7
2	G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.

Reference Books:

1	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021
2	Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
3	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021.



Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC437	Electronic Devices and Circuit Laboratory	PC	0	0	4	2
Course Outcomes						
Upon completion of the course ,students shall have ability to						
C437.1	Understand Characteristics of PN Junction Diode and Zener diode.					[U]
C437.2	Illustrate the Characteristics of Transistors.					[U]
C437.3	Design and Analyzes of Clipper and Clamper circuits					[AN]
C437.4	Apply the working principle of PN junction diode for Rectifiers applications					[AP]
C437.5	Design amplifier and Analyze of frequency response of transistors					[AN]
List of Experiments:						
1	Characteristics of PN Junction Diode					
2	Characteristics of Zener diode					
3	Full Wave Rectifier with Filters					
4	Design of Zener diode Regulator					
5	Clippers and Clampers					
6	Common Emitter input-output Characteristics.					
7	MOSFET Drain current and Transfer Characteristics.					
8	Frequency response of CE amplifiers.					
9	Frequency response of CS amplifiers.					
10	Design and Analysis of the Frequency response of CB amplifiers using SPICE					
11	Design and Analysis of the Frequency response of CC amplifiers using SPICE					
12	Design and Analysis of the tuned Amplifiers using SPICE					
13	Design and Analysis of power amplifier using SPICE					
Total Hours						60
Textbooks:						
1	Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 10th Edition, Pearson Education / PHI, 2008.					
2	Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7 th Edition 2014.					
ReferenceBooks:						
1	Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3 rd Edition, 2010					
2	D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3 rd Edition, 1989					

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24MA243	Probability and Random Process	BS	3	1	0	4
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R24	Analytical	IV	-----			
Course Outcomes						
Upon completion of the course, students shall have ability to						
C243.1	Apply probability theory and random variable concepts to solve relevant problems.					[AP]
C243.2	Understand the knowledge of standard distributions which can describe real life phenomenon.					[AP]
C243.3	Understand the basic concepts of random variables and apply in engineering applications.					[AP]
C243.4	Apply the concept of random processes in engineering disciplines.					[AP]
C243.5	Apply the concept of correlation and spectral densities in communication systems and control systems.					[AP]
Course Contents						
Unit – 1	Probability and Random Variables:					12
Probability – Axioms of probability – Conditional probability – Baye’s theorem - Discrete and Continuous random variables – Moments – Moment generating functions.						
Unit – 2	Probability Distribution:					12
Distribution Functions – Binomial distribution, Poisson distribution, Geometric distribution, Uniform distribution, Exponential distribution and Normal distributions.						
Unit – 3	Two Dimensional Random Variables:					12
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).						
Unit – 4	Random Processes:					12
Classification – Stationary process – Markov process - Markov chain - Poisson process – Random telegraph process.						
Unit – 5	Correlation and Spectral Densities:					12
Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.						
Total Hours						60
Textbooks:						
1	Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007.					
2	P. Z. Peebles and B. E. Shi, Probability, Random Variables and Random Signal Principles, 4th ed. New York: McGraw-Hill Education Asia, 2015.					
ReferenceBooks:						
1	Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd Indian Edition, 2012.					
2	H. P. Hsu, Schaum’s Outline of Probability, Random Variables, and Random Processes, 4th ed. New York: McGraw-Hill, 2019.					
3	S. L. Miller and D. G. Childers, Probability and Random Processes with Applications to Signal Processing and Communications, 2nd ed. Amsterdam: Academic Press, 2012.					
4	H. Stark and J. W. Woods, Probability and Random Processes with Applications to Signal Processing, 4th ed. New Delhi: Pearson Education, 2011.					
5	R. D. Yates and D. J. Goodman, Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers, 3rd ed. Bangalore: Wiley India Pvt. Ltd., 2021.					

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC442	Analog Circuits	PC	3	0	0	3
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R24	Theory	IV	-----			
Course Objectives						
1	To study about feedback amplifiers and oscillators principles					
2	To introduce the basic building blocks of linear integrated circuits					
3	To learn the linear and non-linear applications of operational amplifiers					
4	To introduce the concepts of waveform generation and introduce some special function ICs					
Course Outcomes						
Upon completion of the course, students shall have ability to						
C442.1	Interpret the effect of feedback, feedback amplifier and oscillators					[U]
C442.2	Explain about multistage amplifier type					[U]
C442.3	Illustrate the various linear and non-linear applications of Op-Amp					[AP]
C442.4	Compute different waveform generator circuits using, BJT, opamp and Timer IC-555					[AP]
C442.5	Infer the operation of type of Linear-Digital ICs and Voltage regulator ICs					[U]
Course Contents						
Unit – 1	FEEDBACK AMPLIFIERS					9
Feedback Amplifiers – Concept of negative and positive feedback; Current and Voltage sampling and mixing – different kinds of feedback - Analysis - Effect of feedback on gain - bandwidth - input resistance and output resistance.						
Unit – 2	DIFFERENTIAL AMPLIFIERS					9
BJT Current Mirrors- Simple, Widlar, Wilson - Differential amplifier- Differential and common mode gain - CMRR - Circuits for improving CMRR using active load - Cascode and Darlington amplifiers						
Unit – 3	OP-AMP CHARACTERISTICS AND APPLICATIONS					9
OP-AMP Basics-Ideal Op Amp, Operational Amplifier Internal Circuit, DC Characteristics, AC Characteristics, Slew Rate, Inverting and Non inverting Amplifiers, Voltage Follower, Summing Amplifier, Subtractor, Differentiator, Integrator, Instrumentation amplifier, 1st Order LPF, HPF and all-pass filters.						
Unit – 4	WAVEFORM GENERATORS					9
Barkhausen criterion, Oscillators using BJT: LC, Hartley, Colpitts and Crystal Oscillators-Principles of Op-Amp based Sine Wave Oscillator, -RC Phase Shift, Wien Bridge Oscillator -Multivibrators (Op-Amp & 555) - Astable, Monostable						
Unit – 5	LINEAR-DIGITAL ICs					9
Open Loop Op Amp Configuration, Comparator, Schmitt trigger, Sample and Hold circuits, Flash ADC, Dual Slope ADC - Binary Weighted Resistor DAC - R-2R Ladder DAC, PLL, VCO, Voltage regulator: Fixed and Adjustable						
Total Hours						45
Textbooks:						
1	Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 11th Edition, Pearson Education / PHI, 2015.					
2	D.Roy Choudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd, 5th Edition, 2018.					
ReferenceBooks:						
1	Donald.A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill, 3rd Edition, 2010					
2	Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 4th Edition, Tata Mc Graw-Hill, 2016					

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC443	TRANSMISSION LINES AND RADIATING SYSTEMS	PC	3	1	0	4
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R24	Analytical	IV	-----			
Course Objectives						
1	To introduce the various types of transmission lines and its characteristics					
2	To understand high frequency line, power and impedance measurements					
3	To impart technical knowledge in impedance matching using Smith Chart.					
4	To Study about waveguide structure and its working principles					
5	To gain knowledge about radiating systems					
Course Outcomes						
Upon completion of the course, students shall have ability to						
C443.1	Understand the various types and characteristics of transmission lines, and different types of losses associated with them.					[U]
C443.2	Apply the methods and measurement of standing waves and input impedance in high-frequency transmission lines.					[AP]
C443.3	Apply different wavelengths of transmission lines and perform stub matching for impedance matching using Smith Charts.					[AP]
C443.4	Analyze the field properties of parallel planes, rectangular waveguides, and circular waveguides.					[AN]
C443.5	Understand the characteristics of high-frequency devices and elements in a microwave communication system.					[U]
Course Contents						
Unit – 1	TRANSMISSION LINE BASIC CONCEPTS					9+3
The transmission line, Types, general solution, Infinite line concept, Transmission line parameters, Waveform distortion, distortion less line, Input and transfer impedance, Open and short circuited lines, reflection factor and reflection loss.						
Unit – 2	LINE OPERATING AT HIGH FREQUENCY					9+3
Assumptions for high frequency line, Voltage and current on the dissipation less line, Input impedance of the dissipation less line, Production of Standing Waves, Nodes, Standing Wave Ratio Measurement of VSWR and wavelength.						
Unit – 3	IMPEDANCE MATCHING IN TRANSMISSION LINES					9+3
Input impedance of dissipation less line, Half wave, Quarter wave and one eighth wave line transformer, Transmission line impedance matching techniques, Single and Double Stub matching, Applications of Smith chart.						
Unit – 4	WAVEGUIDE STRUCTURES					9+3
Waves between parallel planes of perfect conductors, TM, TE & TEM Waves, Field Equations in rectangular and circular waveguides, TM and TE Waves in Rectangular and Circular Wave guides, Wave impedance, Excitation of waveguides, Dominant Mode, Field Visualization.						
Unit – 5	FUNDAMENTALS OF RADIATING SYSTEMS					9+3
RF field effect transistors, High electron mobility transistors, Fundamentals of MMIC, RF System Design: Filters, couplers, power dividers, Amplifier power relations, Low noise amplifiers, Power amplifiers, RF Systems, Antenna Systems, Antenna Parameters.						
Total Hours						60
Textbooks:						
1	John D Ryder, “Networks, lines and fields”, 2nd Edition, Prentice Hall India, 2015					
2	E.C. Jordan & K.G. Balmain, “Electromagnetic Waves and Radiating Systems” Prentice Hall of India, 2nd Edition 2011.					
Reference Books:						
1	Annapurna Das, Sisir K. Das, “Microwave Engineering”, McGraw Hill Education (India) private limited, Third edition,2000.					
2	Mathew M. Radmanesh, “Radio Frequency & Microwave Electronics”, Pearson Education Asia, Second Edition, 2002					
3	Annapurna Das, Sisir K. Das, “Microwave Engineering”, McGraw Hill Education (India) private limited, Third edition,2000.					
4	D. K. Misra, “Radio Frequency and Microwave Communication Circuits”- Analysis and Design, John Wiley & Sons, 2004					
5	Reinhold Ludwig “RF Circuit Design: Theory and Applications” 2nd edition 2011					

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC445	Digital Signal Processing and Applications	PC	3	0	2	4
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R24	Analytical	IV	-----			
Course Objectives						
1	To learn discrete fourier transform, properties of DFT and its application to linear filtering					
2	To understand the characteristics of digital filters, design digital IIR and FIR filters and apply these filters to filter undesirable signals in various frequency bands					
3	To understand the effects of finite precision representation on digital filters					
4	To understand the fundamental concepts of multi rate signal processing and its applications					
Course Outcomes						
Upon completion of the course, students shall have ability to						
C445.1	Understand discrete-time signals and systems and analyze signals in the frequency domain using tools like Discrete Fourier Transforms					[U]
C445.2	Design and implement various types of digital IIR filters for specific signal processing Applications					[AP]
C445.3	Design and implement various types of digital FIR filters, for specific signal processing applications					[AP]
C445.4	Address issues related to sampling rate conversion, interpolation, and decimation in digital systems					[AP]
C445.5	Apply Digital Signal Processing in various fields like speech processing and spectrum analysis in various communication systems					[AP]
Course Contents						
Unit – I	DISCRETE FOURIER TRANSFORM					9
Sampling Theorem, concept of frequency in discrete-time signals, summary of analysis & synthesis equations for FT & DTFT, frequency domain sampling, Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT).						
Unit – II	INFINITE IMPULSE RESPONSE FILTERS					9
Characteristics of practical frequency selective filters. Characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.						
Unit – III	FINITE IMPULSE RESPONSE FILTERS					9
Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations						
Unit – IV	FINITE WORD LENGTH EFFECTS					9
Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.						
Unit - V	DSP APPLICATIONS					9
Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization-DSP Architecture-Fixed and Floating point architecture principles						
Total Hours						45
Lab Components						
List of Experiments						
MATLAB / EQUIVALENT SOFTWARE PACKAGE/ DSP PROCESSOR BASED IMPLEMENTATION						CO
1.	Frequency Analysis using DFT					CO1
2.	Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation					CO3
3.	Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations					CO2

4.	Study of architecture of Digital Signal Processor	C05
5.	Generation of elementary Discrete-Time sequences using DSP processor	C01
6.	Linear and Circular convolutions using DSP processor	C01
7.	Auto correlation and Cross Correlation using DSP processor	C01
8.	Generation of various signals and random noise	C04
9.	Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering using DSP processor	C03
10.	Design and demonstration of Butter worth and Chebyshev IIR Filters for Low pass, High pass, Band pass and Band stop filtering using DSP processor	C02
	Total Hours:	30

Textbooks:

1	John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Fourth Edition, Pearson Education / Prentice Hall, 2014.
2	A. V. Oppenheim, R.W. Schaffer and J.R. Buck, –Discrete-Time Signal Processing”, 8th Indian Reprint, Pearson, 2014.

Reference Books:

1	Emmanuel C. Ifeachor & Barrie W. Jervis, “Digital Signal Processing”, Second Edition, Pearson Education / Prentice Hall, 2002.
2	Sanjit K. Mitra, “Digital Signal Processing – A Computer Based Approach”, Tata McGraw Hill, 2007.
3	Andreas Antoniou, “Digital Signal Processing”, Tata McGraw Hill, 2006.

Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24CS346		Data Structures and Algorithms	ES	3	0	2	4
Regulation		Nature of Course	Semester	Data Book/Codes/Standards			
R24		Theory	4	-----			
Course Outcomes Upon completion of the course, students shall have ability to							
C346.1	Understand and implement linear data structures such as lists, stacks, queues, and linked lists, and apply them in solving real-world problems.						U
C346.2	Apply non-linear data structures like trees and their variations to represent hierarchical data efficiently.						AP
C346.3	Demonstrate knowledge of graph data structures and apply graph algorithms in solving complex problems.						AP
C346.4	Analyze algorithms in terms of time and space complexity using asymptotic notations and apply algorithmic paradigms to solve problems.						AP
C346.5	Implement and compare various searching and sorting techniques for problem-solving and optimization.						AP
Course Contents							
Unit-1		Linear ADT					9
List - Arrays - Matrix - String - Applications –Stack - Queue - Circular Queue - Linked List - Singly Linked List, Doubly Linked List, Circular Linked List							
Unit – 2		Non-linear ADT - Trees					9
Tree Terminology - Binary tree - Tree traversals - Expression Tree – Binary Search Tree - AVL Tree - B-tree - Binary Heap - Applications – Dictionary, kth smallest element, Hash Table – Hashing Techniques, Rehashing							
Unit – 3		Non-linear ADT - Graphs					9
Graphs –Graph Terminology – Graph Representation – Graph traversals – Applications –Shortest path algorithm, Minimum Spanning Tree							
Unit – 4		Algorithmic Analysis					9
Asymptotic Measures – Space Complexity – Time Complexity - Divide and Conquer method - Strassen's matrix multiplication - Greedy method - Knapsack problem – Dynamic Programming- Travelling salesman problem.							
Unit – 5		Searching and Sorting Techniques					9
Selection, Bubble, Insertion, Merge, Quick sort - Address calculation - Linear search - Binary search.							
Total Hours							45
Lab Components							
List of Experiments							
1	Implement simple ADTs as Python classes						C01
2	Implement recursive algorithms in Python						C01
3	Linked list implementations of List						C01
4	Implementation of Stack and Queue ADTs						C02
5	Implementation of Hash tables						C02
6	Tree representation and traversal algorithms						C03
7	Implementation of Binary Search Trees						C03
8	Implement Travelling sales man problem						C04
9	Implementation of sorting and searching algorithms						C05
10	Implement Bubble and Quick sort techniques						C05
Total Hours							30
Textbooks:							
1	M. A. Weiss, “Data Structures and Algorithm Analysis in python ”, First Edition, Addition - Wesley professional october 4 2022.						
2	Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser”Data Structures & Algorithms in Python”Publisher: Wiley India Pvt. Ltd. in : 2021						
Reference Books:							
1	T. Cormen, C. Lieserson, R. Rivest, and C. Stein, “Introductions to Algorithms”, PrenticeHall/India, 3rd edition, 2009						
2	M. A. Weiss, “Data Structures and Algorithm Analysis in Java”, Second Edition, Pearson Education, 2014						



Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC447	Analog Circuit Laboratory	PC	0	0	4	2
Course Outcomes						
Upon completion of the course, students shall have ability to						
C447.1	Build and validate the electronic circuits like biasing circuit, amplifier oscillator using BJT					[AP]
C447.2	Demonstrate the various application of op-amp electronic circuit's					[AP]
C447.3	Construct the electronic circuits using timer IC					[AP]
List of Experiments:						
1	Design Series and Shunt feedback amplifiers- and calculate Frequency response, Input and output impedance using SPICE					
2	Design a BJT based Differential Amplifier and calculate CMRR					
3	Design and Analysis the Darlington Amplifier using SPICE					
4	Design and Analysis the frequency response of Cascode amplifier using SPICE					
5	Design of and implement Inverting, Non-Inverting Amplifiers and Voltage Follower					
6	Design of Differentiator and Integrator using IC741.					
7	Design and simulate Transistor based Hartley Oscillator circuit using SPICE					
8	Design and simulate Transistor based Colpitts Oscillator circuit using SPICE					
9	Implement RC-phase shift oscillator using IC741					
10	Implement Wien bridge oscillator using IC741					
11	Design and implement Astable Multivibrator using IC 555.					
12	Design and implement Monostable Multivibrator using IC 555.					
13	Design an Active Low Pass and High Pass Filter using op-amp.					
Total Hours						60
Textbooks:						
1	Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 10th Edition, Pearson Education / PHI, 2008.					
2	Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7 th Edition 2014.					
ReferenceBooks:						
1	Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3 rd Edition, 2010					
2	D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3 rd Edition, 1989					

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**B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
CURRICULUM AND SYLLABI (REGULATION 2024)
(Applicable for students admitted from 2024-2025 Academic Year)**

Service Department Subject

Department	Course Code	Course	L/T/P
EEE-III Sem	24EC333	Digital Logic Circuit	3/0/0
CSE-III SEM	24EC334	Digital system Design	3/0/2
CCE-III Sem	24EC335	Fundamentals of Signal and System	3/1/0
CCE,AIML AIDS-III Sem	24EC336	Digital Principles and Computer Organization	3/0/2
CSE-III Sem	24EC337	Microprocessors and Microcontrollers	3/0/2



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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC333	Digital Logic Circuits	ES	3	0	0	3
Course Outcomes						
Upon completion of the course, students shall have ability to						
C333.1	Manipulate and examine Boolean algebra, logic operations, Boolean functions and their Simplification.					[AP]
C333.2	Design and analyze the combinational logic circuits.					[AN]
C333.3	Design and analyze the sequential logic circuits using Flip Flops.					[AN]
C333.4	Design and analyze the counters and registers using sequential circuits.					[AN]
C333.5	Explain about logic families and programmable logic devices and its operation.					[U]
CourseContents						
Unit – 1	NUMBER SYSTEMS AND LOGIC REDUCTION					9
Introduction to Digital Systems, Review of Number Systems, Representation of signed numbers, Binary Arithmetic using 1s and 2s Complements, Codes and their types. Logic gates, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, AOI, NAND and NOR Implementation - Canonical and Standard Forms of representation, Karnaugh-Map Method (four variable).						
Unit – 2	COMBINATIONAL CIRCUITS					9
Combinational logic – Code converters - Binary adders –Subtractor - Decimal Adders - Binary multiplier - Magnitude comparator -Multiplexers and De multiplexers - Encoders and Decoders – Parity Generator and Checker.						
Unit – 3	SEQUENTIAL LOGIC CIRCUITS					9
Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - Design of synchronous sequential circuits& asynchronous sequential circuits - Analysis of sequential logic circuits– Moore and Mealy models - state diagram - state reduction - state assignment.						
Unit – 4	COUNTERS AND REGISTERS					9
Counters –Synchronous counters - Modulo counters –Ring counters- Johnsons counters- Registers - Shift registers- Universal shift register.						
Unit – 5	LOGIC FAMILIES AND PLDS					9
Digital Logic Families –Introduction to RTL, DTL, TTL, ECL and MOSL families – wired and operation, characteristics of digital logicfamily – Comparison of different logic families-Introduction to Programmability Logic Devices: PROM – PLA –PAL, CPLD-FPGA.						
Total Hours						45
Textbooks:						
1	Morris Mano.M, 'Digital Logic and Computer Design', Prentice Hall of India, 4 th Edition, 2008.					
2	Donald D.Givone, 'Digital Principles and Design', Tata McGraw Hill,1st Edition, 2003					
3	Thomas L Floyd, 'Digital fundamentals', Pearson Education Limited, 11th Edition, 2018					
ReferenceBooks:						
1	Tocci R.J., Neal S. Widmer, 'Digital Systems: Principles and Applications', Pearson Education Asia, 12th Edition, 2017.					
2	Donald P Leach, Albert Paul Malvino, GoutamSha, 'Digital Principles and Applications', Tata McGraw Hill, 7th Edition, 2010.					

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC334	DIGITAL SYSTEM DESIGN	ES	3	0	2	4
Course Outcomes						
Upon completion of the course, students shall have ability to						
C334.1	Understand and Apply Boolean Algebra					[AP]
C334.2	Design and Implement Combinational Logic Circuits					[AP]
C334.3	Design and Implement Synchronous Sequential Circuits					[AP]
C334.4	Design and Implement Asynchronous Sequential Circuits					[AP]
C334.5	Understand Memory and Programmable Logic Devices					[U]
Course Contents						
Unit – 1	BOOLEAN ALGEBRA AND LOGIC GATES					9
Number Systems — Arithmetic Operations — Binary Codes- Boolean Algebra and Logic Gates — Theorems and Properties of Boolean Algebra — Boolean Functions — Canonical and Standard Forms — Simplification of Boolean Functions using Karnaugh Map — Logic Gates — NAND and NOR Implementations.						
Unit – 2	COMBINATIONAL LOGIC					9
Combinational Circuits — Analysis and Design Procedures — Binary Adder-Subtractor — Decimal Adder — Binary Multiplier — Magnitude Comparator — Decoders — Encoders — Multiplexers — Introduction to HDL — HDL Models of Combinational circuits.						
Unit – 3	SYNCHRONOUS SEQUENTIAL LOGIC					9
Sequential Circuits — Storage Elements: Latches , Flip-Flops — Analysis of Clocked Sequential Circuits — State Reduction and Assignment — Design Procedure — Registers and Counters — HDL Models of Sequential Circuits.						
Unit – 4	ASYNCHRONOUS SEQUENTIAL LOGIC					9
Analysis and Design of Asynchronous Sequential Circuits — Moore and Melay models— Reduction of State and Flow Tables — Race-free State Assignment — Hazards.						
Unit – 5	MEMORY AND PROGRAMMABLE LOGIC					9
RAM — Memory Decoding — Error Detection and Correction — ROM — Programmable Logic Array — Programmable Array Logic — Sequential Programmable Devices.						
Hours						45
List of Experiments						
1.	Verification of NAND, NOR, Ex-OR,AND& OR Gates.					
2.	Implementation of Half Adder & Full Adder					
3.	Implementation of Half Subtractor& Full Subtractor.					
4.	Implementation of Encoder/ Decoder.					
5.	Implementation of Multiplexer/ Demultiplexer.					
6.	Implementation of Code converters.					
7.	Implementation of BCD Adder.					
8.	Verification of various flip-flops.					
9.	Implementation of Counters.					
10.	Implementation of shift registers.					
11.	Simulation of combinational logic circuits using HDL					
12.	Simulation of sequential logic circuits using HDL					
Hours						30
Total Hours						(45+30) = 75
1	Moris Mano, —Digital Logic and Computer Design, PHI Publications, 2002					
2	R. P.Jain, —Modern Digital Electronics, TMH, 3rd Edition, 2003.					
Reference Books:						
1	Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.					
2	R.L. Tokheim, —Digital Electronics, Principles and Applicationsll, Tata McGraw Hill, 1999.					
3	S. Salivahanan& S. Arivvyhgan. —Digital circuits and designll, Vikas Publication, 2001					
Online links for study & reference materials						
1	https://nptel.ac.in/courses/117/106/117106086/					



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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC335	Fundamentals of Signals and Systems	ES	3	1	0	4
Course Outcomes						
Upon completion of the course, students shall have ability to						
C335.1	Understand the signal classification, manipulations and system classifications					[U]
C335.2	Analyze time and frequency domain components of continuous time signal					[U]
C335.3	Define the time domain and frequency domain characteristics of continuous LTI systems					[AP]
C335.4	Analyze time and frequency domains components of discrete time signals					[U]
C335.5	Determine an LTI system's output in the frequency and time domains					[AP]
Course Contents						
Unit – 1	CLASSIFICATION OF SIGNALS AND SYSTEMS					9+3
Standard signals —Step, Ramp, Pulse, Impulse, Exponential and Sinusoidal — Signal Manipulations — Classification of signals — Continuous Time/Discrete Time, Periodic/Aperiodic signals, Even/Odd, Energy/Power signals — Classification of systems— Continuous Time/Discrete Time, Linear/Nonlinear, Time-variant/Time-invariant, Causal/Non-causal, Stable /Unstable						
Unit – 2	ANALYSIS OF CONTINUOUS TIME SIGNALS					9+3
Fourier series approximation — Fourier Transform — Properties of Fourier Transform — Laplace Transforms — Properties of Laplace Transforms						
Unit – 3	LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS					9+3
Impulse response — Convolution Integrals— Differential Equation— Fourier and Laplace transforms in Analysis of CT systems — CT systems Realizations						
Unit – 4	ANALYSIS OF DISCRETE TIME SIGNALS					9+3
Sampling Process — Discrete Time Fourier Transform (DTFT) — Properties of DTFT — Z-Transform, Properties of Z-Transform						
Unit – 5	LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS					9+3
Impulse response — Convolution sum—Difference Equations— Discrete Fourier Transform & Z-Transform Analysis of Discrete Time LTI systems—DT systems Realizations						
Total Hours						60
Textbooks:						
1	Oppenheim, Willsky and Hamid, “Signals and Systems”, 2nd Edition, Pearson Education, New Delhi, 2015					
2	Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd Edition, Wiley, 2002					
ReferenceBooks:						
1	M. J. Roberts, “Signals and Systems Analysis using Transform methods and MATLAB”, McGraw- Hill Education, 2018					
2	John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.					

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
EC337	Digital Principles and Computer Organization	ES	3	0	2	4
Course Outcomes (s)						
Upon completion of the course, students shall have ability to						RBT
CO1	Compute various combinational digital circuits using logic gates					AP
CO2	Apply design procedure for sequential circuits in digital system					AP
CO3	Explain the fundamentals of computer systems and the execution of an instruction					U
CO4	Perform different types of control design and identity hazards					AP
CO5	Identify the characteristics of various memory systems and illustrate functioning of I/O devices					U

Course Content		
Unit – I	COMBINATIONAL LOGIC	9
Combinational Circuits – Karnaugh Map - Analysis and Design Procedures – Binary Adder – Subtractor – Decimal Adder - Magnitude Comparator –single-bit, four- bit- Decoder – two to four-Three to eight- 4 to 16- Encoder – octal to binary-priority-Multiplexers - 2:1-4:1- quadruple 2 to1-Demultiplexers-1:4-1:8		
Unit – II	SYNCHRONOUS SEQUENTIAL LOGIC	9
Introduction to Sequential Circuits – Flip-Flops – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, state assignment, circuit implementation - Registers – Shift register-Universal shift register-Counters-ripple counter-ring counter-Johnson counter.		
Unit – III	COMPUTER FUNDAMENTALS	9
Functional Units of a Digital Computer: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Instruction Set Architecture (ISA): Memory Location, Address and Operation – Instruction and Instruction Sequencing – Addressing Modes, Encoding of Machine Instruction – Interaction between Assembly and High Level Language.		
Unit – IV	PROCESSOR	9
Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control, Micro-programmed Control – Pipelining – Data Hazard – Control Hazards.		
Unit – V	MEMORY AND I/O	9
Memory Concepts and Hierarchy – Memory Management – Cache Memories: Mapping and Replacement Techniques – Virtual Memory – DMA – I/O – Accessing I/O: Parallel and Serial Interface – Interrupt I/O – Interconnection Standards: USB, SATA		
		TOTAL: 45 Hours
List of Experiments:		30 Hours
1. Verification of Boolean theorems using logic gates.		
2. Design and implementation of combinational circuits using gates for arbitrary functions.		
3. Implementation of 4-bit binary adder/subtractor circuits.		
4. Implementation of code converters.		
5. Implementation of BCD adder, encoder and decoder circuits		
6. Implementation of functions using Multiplexers.		
7. Implementation of the synchronous counters		
8. Implementation of a Universal Shift register.		
9. Simulator based study of Computer Architecture		
Learning Resources		
Textbooks		
1	M. Morris Mano, Michael D. Ciletti, “Digital Design : With an Introduction to the Verilog HDL, VHDL, and System Verilog”, Sixth Edition, Pearson Education, 2018.	
2	David A. Patterson, John L. Hennessy, “Computer Organization and Design, The Hardware/Software Interface”, Sixth Edition, Morgan Kaufmann/Elsevier, 2020.	
Reference Books		
1	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, “Computer Organization and Embedded Systems”, Sixth Edition, Tata McGraw-Hill, 2012.	
2	William Stallings, “Computer Organization and Architecture – Designing for Performance”, Tenth Edition, Pearson Education, 2016.	
3	M. Morris Mano, “Digital Logic and Computer Design”, Pearson Education, 2016.	



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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC377	Microprocessors and Microcontrollers	ES	3	0	0	3
Course Outcomes						
Upon completion of the course, students shall have ability to						
C377.1	Understand the architecture and Interrupt structure of 8085 Microprocessor					U
C377.2	Apply 8085 instructions and addressing modes to write assembly level programs					AP
C377.3	Understand the architecture, addressing modes, Interrupt structure of 8051 and assembly language instruction set					U
C377.4	Understand and perform programming of 8051 microcontroller using C programming					AP
C377.5	Interfacing peripherals and programmable devices with 8085 and 8051					AP
Course Contents						
Unit – 1	INTRODUCTION TO 8085 ARCHITECTURE					7
Functional block diagram – Memory interfacing-I/O ports and data transfer concepts – Timing Diagram — Interrupt structure						
Unit – 2	8085 INSTRUCTION SET AND PROGRAMMING					10
Instruction format and addressing modes — Assembly language format — Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing – Look up table – Subroutine instructions, stack						
Unit – 3	INTRODUCTION TO 8051 MICROCONTROLLER					9
8051 Microcontroller Architecture - Instruction Set - Addressing Modes and Data Types-- Assembly Level Programming with 8051 - Interrupts – I/O Ports Timers – Serial Communication						
Unit – 4	8051 PROGRAMMING BASICS IN C					10
Data types and Time Delays in C – Logic Operations in C – Data conversion in C – Accessing ROM – Data Serialization – I/O programing – Interrupt programming in C						
Unit – 5	INTERFACING PERIPHERALS and INTRODUCTION TO RISC BASED ARCHITECTURE					9
8085 Interfacing: Study of Architecture and programming of ICs: 8255, Interfacing Keyboard and Seven segment display, 8254 Timer/Counter. 8051 Interfacing: LCD and Keyboard interfacing using 8051, Stepper motor control. Introduction to RISC architecture and embedded systems						
Total Hours						45
List of Experiments						
1.	Addition and Subtraction of Single and Multi byte data					
2.	Multiplication and Division of Single and Multi byte data					
3.	Move a data block without overlap					
4.	Counters and Time Delay					
5.	Traffic light controller					
6.	Stepper motor control					
7.	Bit Manipulation and Masking Program for 8051					
8.	A/D and D/A interface and Waveform Generation					
9.	Basic arithmetic and Logical operations using 8051					
10.	Square and Cube program, Find 2's complement of a number					
11.	Timer Programming with Keil C for 8051					
12.	Serial Port Programming with Keil C					
Textbooks:						
1	Ramesh S. Gaonkar, 'Microprocessor Architecture Programming and Application', Pen ram International (P)ltd., Mumbai, 6th Education, 2013					
2	Muhammad Ali Mazidi & Janice Gilli Mazidi, 'The 8051 Micro Controller and Embedded Systems', Pearson Education, Second Edition 2011					
Reference Books:						
1	Douglas V. Hall, "Micro-processors & Interfacing", TMGH 3rd Ed., 2017.					
2	Krishna Kant, "Micro-processors & Micro-controllers", PHI, 2007.					
3	Mike Predko, "8051 Micro-controllers", McGraw Hill, 2009.					

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	V	-----			
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 apply various techniques to lead and motive 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	Apply various motivational and leadership theories in directing the workforce, improve their performance.					[AP]
CS151.5	Take effective steps in controlling & coordinating various resources in the organization.					[AP]
Course Contents						
Unit – 1	INTRODUCTION TO MANAGEMENT				CO1	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				CO2	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				CO3	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				C04	9
Directing: Meaning-Nature - Importance–principles – Elements of Directing. Motivation – Motivation theories (Maslow, Herzberg, ERG, X and Y theories)– Motivational techniques – Job satisfaction – Job enrichment – 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	CO5	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-Crisis Management – Knowledge Management – Risk Management –Artificial Intelligence – Business Analytics – Six Sigma management – meaning- importance.			
Total Hours			45
Textbooks:			
1	P.C.Tripathy, P.N.Reddy, Ashish Bajpai Principles of Management,7th Edition, Tata McGraw Hill Education Pvt Ltd, NewDelhi (2023)		
2	Harold Knootz, Heinz Weinhrich, Essential of Management, 11th Edition, Tata McGraw Hill Education Pvt Ltd, New Delhi. (2021)		
3	Stephen P Robbins ,Mary Coulter& David De Cenzo, Fundamentals of Management: Essential Concepts and Applications, 9th Edn (2016)		
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, Sultan Chand & Sons New Delhi (2024)		
3	Dr Mosham Sinha & Dr Deepali Kapoor, Fundamentals of Management, DPS Publishing House,(2022)		
4	Mrs M Saravanapriya, Fundamentals of Management, Astitva Prakashan, (2024)		
Web References:			
1	https://file-dhaka.portal.gov.bd/uploads/0283d03a-254c-4b8c-9db4-4060c02f16c2/629/c3c/ee6/629c3cee6adc6386614665.pdf		
2	https://www.freebookcentre.net/business-books-download/Introduction-to-Principles-of-Management.html		

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						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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

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

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EE352	Control Systems Engineering	ES	3	1	0	4
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
2024	Analytical	V	-			
Pre-requisite Course(s)		Co-requisite Course(s)				
Signal and System						
Course Objectives						
1	To familiarize with various representations of systems.					
2	To analyze the stability of linear systems in the time domain and frequency domain.					
3	To analyze the stability of linear systems in the frequency domain.					
4	To design compensator based on the time and frequency domain specifications.					
5	To develop linear models: mainly state variable model and Transfer function model					
Course Outcomes						
Upon completion of the course, students will be able to						
C352.1	Use transfer function techniques to model and represent simple systems.					[AP]
C352.2	Determine system responses in the time domain for simple systems.					[AN]
C352.3	Evaluate system behavior in the frequency domain using appropriate methods.					[AN]
C352.4	Determine the stability of systems using time-domain and frequency-domain criteria.					[AP]
C352.5	Model and interpret system behavior using system characteristics and state variable representation.					[AP]
Course Contents						
Unit – 1	SYSTEMS COMPONENTS AND THEIR REPRESENTATION				CO1	9+3
Control System: Terminology and Basic Structure-Feed forward and Feedback control theory- Electrical and Mechanical Transfer Function Models- Block diagram Models-Signal flow graphs models-DC and AC servo Systems						
Unit – 2	TIME RESPONSE ANALYSIS				CO2	9+3
Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI,PID control systems						
Unit – 3	FREQUENCY RESPONSE AND SYSTEM ANALYSIS				CO3	9+3
Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot- Nyquist plots-Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation						
Unit – 4	CONCEPTS OF STABILITY ANALYSIS				CO4	9+3
Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept - Nyquist stability criterion.						
Unit – 5	CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS				CO5	9+3
State variable representation-Conversion of state variable models to transfer functions- Multivariable control system - Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback.						

Total Theory Hours		60
Textbooks:		
1	Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers 2010.	
2	Benjamin C. Kuo, “Automatic Control Systems”, 7th edition PHI Learning Private Ltd, 2010.	
Reference Books:		
1	Katsuhiko Ogata, “Modern Control Engineering”, PHI Learning Private Ltd, 5thEdition, 2010.	
2	John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.	
3	Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Education Pearson, 3 Impression 2009.	
Web References:		
1	NPTEL Video Lecture Notes on “Control Engineering” by Prof.S.D.Agashe, IIT Bombay	

BLOOM'S TAXONOMY LEVEL	ASSESSMENT			ASSIGNMENT	ATTENDANCE	END SEMESTER EXAMINATION
	CIA1	CIA2	MODEL			
	6	6	8			
Remember					10	60
Understand	50%	30%	30%	5		
Apply	50%	50%	50%			
Analyze		20%	20%	5		
Evaluate						
Create						
Total(100Marks)	6	6	8	10	10	60

- 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.

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PSO 1	PSO 2
C352.1	3	3	3	2							3	2	3
C352.2	3	3	3	2							3	2	3
C352.3	3	3	3	2							3	2	3
C352.4	3	3	3	2							3	2	3
C352.5	3	3	3	2							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		
24EC453	CMOS VLSI Design	PC	3	0	0	3	
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards				
2024	Theory and Design Concept	V	----				
Pre-requisite Course(s)		Co-requisite Course(s)					
Digital Logic Circuit Design		NIL					
Course Objectives							
1	To understand the basic principles and operation of MOS transistors and CMOS inverters.						
2	To study the design techniques of CMOS combinational logic circuits and their performance.						
3	To learn the design and operation of sequential circuits and clocking strategies used in VLSI systems.						
4	To understand the design of arithmetic building blocks such as adders, multipliers, and shifters.						
5	To study VLSI implementation strategies including standard cell design, FPGA architecture, and ASIC design flow.						
Course Outcomes: Upon completion of the course, students will be able to							
C453.1	Understand the operation of MOS transistors and CMOS inverter characteristics.					[U]	
C453.2	Design and analyze CMOS combinational logic circuits.					[AP]	
C453.3	Explain the working of sequential circuits and clocking strategies.					[U]	
C453.4	Design arithmetic building blocks used in VLSI systems.					[AP]	
C453.5	Understand VLSI implementation techniques and ASIC design flow.					[AP]	
Course Contents							
Unit – 1	MOS TRANSISTOR PRINCIPLES					CO1	9
MOS operating modes, Pass transistors, Characteristics of CMOS inverter, Scaling principles and fundamental limits. Propagation Delays, CMOS inverter scaling, Elmore’s constant.							
Unit – 2	COMBINATIONAL LOGIC CIRCUITS					CO2	9
Static CMOS logic Design, Design techniques to improve the speed, power dissipation of CMOS logic, Ratioed logic, Pass transistor Logic, Transmission CPL, DCVSL, Dynamic CMOS logic, Domino logic, Dual Rail logic, NP CMOS logic and NORA logic, Stick diagram, Layout diagrams, Logical Effort.							
Unit – 3	SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES					CO3	9
Static and Dynamic Latches and Registers, Timing Issues, Pipelines, Clocking strategies, Memory architectures							
Unit – 4	DESIGNING ARITHMETIC BUILDING BLOCKS					CO4	9
Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters.							
Unit – 5	IMPLEMENTATION STRATEGIES					CO5	9
Full Custom and Semicustom Design, StandardCell design and cell libraries, FPGA building block architectures, FPGA interconnect. ASIC Design flow							
Total Hours						45	
Textbooks:							
1	Jan Rabaey, Anantha Chandrakasan, B.Nikolic, “Digital Integrated circuits: A DesignPerspective”, Prentice Hall of India, 2nd Edition, 2003.						
2	N.Weste, K.Eshraghian, “Principles of CMOS VLSI DESIGN”, A system						

	Perspective, 2 nd Edition, Addison Wesley, 2004
Reference Books:	
1	A.Pucknell, Kamran Eshraghian, “BASIC VLSI DESIGN”, Prentice Hall of India, 3 rd Edition, 2
2	M.J. Smith, “Application Specific Integrated Circuits”, Addison Wesley, 1997
3	R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India, 2005.
Web References:	
1	https://vlsiworlds.com/wp-content/uploads/2021/04/cmos-vlsi-design-by-westee.pdf

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%	35%			
Apply	40%	60%	65%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C453.1	3	2	2	1	2						1	3	3
C453.2	3	3	2	1	2						1	3	3
C453.3	3	2	3	1	2						1	3	3
C453.4	3	3	2	1	2						1	3	3
C453.5	2	2	2	1	3						1	3	3

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

Prepared by

Ms. M. Thamaraiselvi, AP/ECE

Approved by

Dr.N.K.Anushkannan HoD/ECE

Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24EC456		Analog Communication	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 Random Processes , Analog Circuits			-----				
Course Objectives							
1	To understand the basic principles of analog communication systems and the role of modulation in signal transmission.						
2	To study the generation and detection techniques of Amplitude Modulation (AM) and Frequency Modulation (FM) systems.						
3	To analyze the impact of noise in communication systems and evaluate the performance of communication receivers						
4	To learn the principles of sampling and pulse analog modulation techniques such as PAM, PWM, and PPM.						
Course Outcomes:Upon completion of the course, students will be able to							
C456.1	Illustrate the mathematical model for generation and detection of different AM systems base on time domain representation and its spectrum						[U]
C456.2	Describe about Frequency Modulation and Demodulation						[U]
C456.3	Analyze the effect of noise on communication receivers.						[AN]
C456.4	Compute the noise performance of AM and FM receivers.						[AP]
C456.5	Apply the concepts of the sampling process and determine the characteristics of Pulse Analog Modulation schemes						[AP]
Course Contents							
Unit – 1	AMPLITUDE MODULATION SYSTEMS					CO1	9+9
Generation and demodulation of AM, DSB-SC, SSB-SC, VSB Signals, Filtering of sidebands, Comparison of Amplitude modulation systems, Frequency translation, Frequency Division multiplexing, AM transmitters, AM receivers- Super heterodyne receivers and their characteristics.							
PRACTICAL:							
1. Amplitude modulation and demodulation							
2. Simulation of DSB-SC Modulation							
3. Simulation of SSB-SC Modulation							
Unit – 2	FREQUENCY MODULATION SYSTEMS					CO2	9+3
Angle modulation, frequency modulation, Narrowband and wideband FM, transmission bandwidth of FM signals, Generation of FM signal: Direct FM, indirect FM, Demodulation of FM signals, FM stereo multiplexing, PLL: Nonlinear model and linear model of PLL, Non-linear effects in FM systems, FM Broadcast receivers, FM stereo receiver							
PRACTICAL:							
1. Frequency modulation and demodulation							
Unit – 3	NOISE PERFORMANCE OF DSB, SSB RECEIVERS					CO3	9+3
Noise: Shot noise, thermal noise, White noise, Noise equivalent Bandwidth, Narrowband noise,							

Representation of Narrowband noise in terms of envelope and phase components, Sine wave plus Narrowband Noise, Receiver model, Noise in DSB-SC receiver, Noise in SSB receiver.			
PRACTICAL:			
1. Simulation of Mixer Circuits			
Unit – 4	NOISE PERFORMANCE OF AM AND FM RECEIVERS	CO4	9+3
Noise in AM receivers threshold effect, Noise in FM receivers capture effect, FM threshold effect, FM threshold reduction, Pre-emphasis and de-emphasis in FM, Comparison of performance of AM and FM systems.			
PRACTICAL: 1.Pre-emphasis and de-emphasis in FM			
Unit – 5	PULSE MODULATION	CO5	9+12
Sampling process: sampling theorem for band limited signals, ideal and practical sampling, Antialiasing and reconstruction filters, Generation and detection of Pulse Amplitude Modulation (PAM), Generation and detection of Pulse Width Modulation (PWM), Generation and detection of Pulse Position Modulation (PPM), Generation and detection of Pulse Time Modulation (PTM), Time division Multiplexing, Crosstalk effect.			
PRACTICAL:			
1. Sampling and Reconstruction			
2. Pulse Amplitude Modulation			
3. Pulse Width and Pulse Position Modulation			
4. Time Division Multiplexing			
Total Theory Hours			45
Total Practical Hours			30
Textbooks:			
1	Simon Haykin, Communication Systems, John Wiley & sons, NY, 5th Edition, 2016		
2	Michael P. Fitz, Fundamentals of Communication Systems, Tata McGraw-Hill, 2nd Edition-2013.		
Reference Books:			
1	Taub and Schilling, Principles of communication systems, TMH, New Delhi, 4th Edition, 2017		
2	Br Bruce Carlson et al, Communication systems, McGraw-Hill Int., 4th Edition, 2007 Carlson et al, Communication systems, McGraw-Hill Int., 4th Edition, 2007		
Web References:			
1	https://onlinecourses.nptel.ac.in/noc21_ee74/preview		

BLOOM'S TAXONOMY LEVEL	ASSESSMENT-1			ASSESSMENT-2		ASSIGNMENT	ATTENDANCE	END SEMESTER EXAMINATION
	CIA1	CIA2	MODEL	LAB EXPERI MENTS	MODEL LAB EXAM			
	6	6	8	15	5			
Remember	20%		10%	15	5	10	10	40
Understand	80%	10%	40%					
Apply		70%	30%					
Analyze		20%	20%					
Evaluate								
Create								
Total(100 Marks)	6	6	8	15	5	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.

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO2
C456.1	3	2	2		3	2		2	2			2	3
C456.2	3	2	2			2		2	2			2	3
C456.3	3	3	2								2	2	3
C456.4	3	3	2		3	2		2	2		2	2	3
C456.5	3	3	2			2		2	2		2	2	3

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

Prepared by
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Approved by
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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC457	Microcontrollers and Interfacing	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)				
Digital System Design		-----				
COURSE OBJECTIVES						
1	To understand the architecture, addressing modes, instruction set and interrupt structure of the 8085 microprocessor and develop assembly language programs.					
2	To explain the architecture, addressing modes, interrupts and instruction set of the 8051 microcontroller and perform programming using C language.					
3	To study the architecture, memory organization, addressing modes and instruction set of PIC microcontrollers.					
4	To understand the interfacing techniques of microcontrollers with external devices and peripherals.					
5	To develop microcontroller-based applications using basic interfacing techniques and embedded programming.					
Course Outcomes: Upon completion of the course, students shall have ability to						
C457.1	Understand the 8085 architecture and interrupt structure, and utilize its instructions and addressing modes to write assembly programs.					[U]
C457.2	Explain the 8051 architecture, addressing modes, interrupt structure and instruction set, and perform programming in C.					[AP]
C457.3	Explain the PIC architecture, memory organization, addressing modes and instruction set.					[U]
C457.4	Explain the interfacing technique and implement it.					[AP]
C457.5	Explain the basic interfacing techniques and implement microcontroller-based applications					[AP]
Course Contents						
Unit – 1	8085 MICROPROCESSOR				CO1	9
8085 Internal architecture, Addressing modes, Instruction set, Memory Interfacing, I/O Ports, Timing diagram, Interrupts structure, Assembly Language programming.						
Unit – 2	8051 MICROCONTROLLER				CO2	9+10
Microcontroller 8051 Architecture, RAM-ROM Organization, Machine Cycle, Instruction set: Addressing modes, Data Processing - Stack, Arithmetic, Logical; Branching – Unconditional and Conditional, Assembly programming. I/O Ports, Timers-Counters, Serial Communication and Interrupts.						
PRACTICAL EXPERIMENTS WITH μ C8051:						
Simple arithmetic operations with 8051: Multi precision addition / subtraction /multiplication/ division.						
Programming with control instructions: Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers, Rotate instructions.						
Unit – 3	PIC MICROCONTROLLERS				CO3	9+10
PIC Architecture, Memory organization, Addressing modes, Instruction set, PIC Programming in C, Timers – I/O ports –Serial port programming, Interrupts programming.						
PRACTICAL EXPERIMENTS WITH PIC:						
Simple arithmetic operations with PIC: Multi precision addition / subtraction /multiplication/ division.						

Programming with control instructions: Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers, Rotate instructions.			
Unit – 4	INTERFACING BASICS AND ICS	CO4	9
Study of Architecture and programming of ICs: 8255 PPI, 8259PIC, 8251 USART, 8279 Keyboard display controller and 8254 Timer/Counter.			
Unit – 5	I/O INTERFACING WITH MICROCONTROLLER	CO5	9+10
8051 Interfacing: LCD, LED, Keypad, Analog-to-Digital Convertors, Digital-to-Analog Convertors, Sensor with Signal Conditioning Interface. PIC Interfacing: LCD and Keyboard interfacing, Stepper motor control, ADC, DAC and Sensor Interfacing.			
PRACTICAL EXPERIMENTS BASED ON INTERFACING - µC8051/PIC:			
1. A/D Interfacing, D/A Interfacing. 2. Traffic light controller. 3. Stepper motor controller interface. 4. Displaying a moving/ rolling message in the student trainer kit’s output device.			
		Total Theory Hours	45
		Total practical Hours	30
Textbooks:			
1	Ramesh S. Gaonkar, ‘Microprocessor Architecture Programming and Application’, Pen ram International (P) ltd., Mumbai, 6th Education, 2013.		
2	Muhammad Ali Mazidi& Janice GilliMazidi, ‘The 8051 Micro Controller and Embedded Systems’, Pearson Education, Second Edition 2011.		
Reference Books:			
1	Douglas V. Hall, “Micro-processors & Interfacing”, TMGH 3rd Ed., 2017.		
2	Krishna Kant, “Micro-processors & Micro-controllers”, PHI, 2007.		
3	MykePredko, “Programming and customizing the PIC microcontroller”, Tata McGraw Hill Publishing Company Limited, Third Edition, 2008.		
4	PIC Micro mid-Range MCU Family Reference Manual - Micro Chip Technology Inc.		
Web References			
1	https://onlinecourses.nptel.ac.in/noc22_ee12/preview		
2	https://nptel.ac.in/courses/117104072		

BLOOM'S TAXONOMY LEVEL	ASSESSMENT-1			ASSESSMENT-2		ASSIGNMENT	ATTENDANCE	END SEMESTER EXAMINATION
	CIA1	CIA2	MODEL	LAB EXPERI MENTS	MODEL LAB EXAM			
	6	6	8	15	5			
Remember	20%	10%	10%					
Understand	60%	60%	60%					
Apply	30%	30%	30%	15%	5%			
Analyze								
Evaluate								
Create								
Total(100 Marks)	6	6	8	15	5	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.

COs/ POs	P O1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2
C457.1	3	3	3	3	3	-	-	-	1	-	3	3	3
C457.2	3	3	3	3	3	-	-	-	1	-	3	3	3
C457.3	3	3	3	3	3	-	-	-	1	-	3	3	3
C457.4	3	3	3	3	3	-	-	-	1	-	3	3	3
C457.5	3	3	3	3	3	-	-	-	1	-	3	3	3

Prepared by

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Course Code		Course Name	Category	Hours/Week			C	
				L	T	P		
24EC458		CMOS VLSI Design Laboratory	PC		0	0	4	2
Regulation		Nature of the Course		Semester	Data Book/Codes/Standards			
2024		Practical		V	-----			
Pre-requisite Course(s)				Co-requisite Course(s)				
Digital Logic Circuit Design				CMOS VLSI Design				
Course Objectives								
1	To familiarize students with HDL based digital circuit design using tools like Xilinx or Altera.							
2	To design and simulate basic digital arithmetic circuits and sequential circuits using HDL.							
3	To implement digital circuits such as adder, multiplier, ALU, and shift registers on FPGA platforms.							
4	To understand the design and simulation of CMOS digital circuits including logic gates and flip-flops.							
5	To analyze and simulate CMOS analog circuits and amplifiers using digital design flow tools.							
Course Outcomes: Upon completion of the course, students will be able to								
C458.1	Design and simulate basic arithmetic circuits (adder, multiplier) using HDL and verify the results using FPGA tools.							[AP]
C458.2	Design and implement digital systems like ALU and verify their functionality using FPGA platforms.							[AP]
C458.3	Develop and implement sequential circuits such as FSMs, shift registers, counters, and memories using HDL.							[AP]
C458.4	Design and simulate CMOS digital circuits including inverters, logic gates, and flip-flops using CAD tools.							[AP]
C458.5	Analyze and simulate basic CMOS analog amplifiers such as common source, common gate, common drain, and inverting amplifier circuits.							[AN]
List of Experiments:								CO
PART I								
1	Design an Adder (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software andimplement by Xilinx/Altera FPGA							CO1
2	Design a Multiplier (4 Bit Min) using HDL. Simulate it using Xilinx/Altera Software andimplement by Xilinx/Altera FPGA							CO1
3	Design an ALU using HDL. Simulate it using Xilinx/Altera Software and implement byXilinx/Altera FPGA							CO2
4	Design a Universal Shift Register using HDL. Simulate it using Xilinx/Altera Softwareand implement by Xilinx/Altera FPGA							CO3
5	Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/AlteraSoftware and implement by Xilinx/Altera FPGA							CO3
6	Design Memories using HDL. Simulate it using Xilinx/Altera Software and							CO3

	implementby Xilinx/Altera FPGA	
PART II		
7	Design and simulate a CMOS inverter using digital flow	CO4
8	Design and simulate a CMOS Basic Gates	CO4
9	Design and simulate Flip-Flops	CO4
10	Design and simulate a 4-bit synchronous counter using a Flip-Flops	CO4
11	Design and Simulate a CMOS Inverting Amplifier.	CO5
12	Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers.	CO5
Tools: Xilinx ISE/Altera Quartus/ equivalent EDA Tools along with Xilinx/Altera/equivalent FPGA Boards Cadence/Synopsis/ Mentor Graphics/Tanner/equivalent EDA Tools		
Total Hours		60

BLOOM'S TAXONOMY LEVEL	ASSESSMENT		ATTENDANCE	END SEMESTER EXAMINATION
	EVALUATION OF LAB OBSERVATION, RECORD [75%]	MODEL LAB EXAM [25%]		
	38	12		
Remember			10	40
Understand				
Apply	60%	60%		
Analyze	40%	40%		
Evaluate				
Create				
Total (100 Marks)	38	12	10	40

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C458.1	3	2	3	2	3						1	3	3
C458.2	3	2	3	2	3						1	3	3
C458.3	3	2	3	2	3						1	3	3
C458.4	3	2	3	2	3						1	3	3
C458.5	3	2	3	2	3						1	3	3

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

Prepared by
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Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24EC461		Antennas and Wave Propagation	PC	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)			
Electromagnetic Fields and waves, Transmission Line and Radiating System				-----			
Course Objectives							
1	To enable the students to gain knowledge of antenna fundamentals and radiation mechanisms						
2	To familiarize the students with the linear wire antennas and basic structures.						
3	To learn the concepts of antenna arrays and apply pattern synthesis techniques						
4	To know the concepts of aperture antennas and modern structures						
5	To introduce the basics of radio wave propagation concepts						
Course Outcomes							
Upon completion of the course, students will be able to							
C461.1	Understand antenna radiation principles and antenna parameters.						[U]
C461.2	Analyze radiation characteristics of wire antennas.						[AN]
C461.3	Apply array theory to determine antenna radiation patterns.						[AP]
C461.4	Explain operation of aperture and modern antennas.						[U]
C461.5	Describe different radio wave propagation mechanisms.						[U]
Course Contents							
Unit – 1	Fundamentals of Antennas and Radiation Mechanism					CO1	9
Introduction to antennas and their role in communication systems. Radiation mechanism and principle of radiation. Fields of a short dipole and radiation from oscillating current elements. Near-field and far-field regions. Basic antenna parameters: radiation pattern, beamwidth, beam solid angle, radiation intensity, directivity, gain and efficiency. Antenna impedance, polarization, effective aperture and effective length. Reciprocity theorem and Friis transmission formula. Antenna temperature and system considerations.							
Unit – 2	Linear Wire Antennas and Basic Antenna Structures					CO2	9
Radiation from thin linear antennas. Short dipole and half-wave dipole antennas – current distribution, radiated fields and radiation resistance. Quarter-wave monopole antenna and folded dipole antenna. Loop antennas – small loop antenna characteristics. Traveling wave antennas – V antenna and Rhombic antenna. Basic design considerations and applications of wire antennas.							
Unit – 3	Antenna Arrays and Pattern Synthesis					CO3	9
Concept of antenna arrays and advantages. Point sources and arrays of two isotropic sources. Uniform linear arrays. Broadside arrays and end-fire arrays. Principle of pattern multiplication. Array factor and radiation pattern formation. Binomial arrays and amplitude distribution. Introduction to phased arrays and basic antenna synthesis concepts.							
Unit – 4	Aperture Antennas and Modern Antenna Structures					CO4	9
Aperture antennas – slot antennas and horn antennas. Reflector antennas – flat sheet, corner reflector and parabolic reflector antennas and feed methods. Helical antennas and log-periodic antennas. Microstrip patch antennas – basic structure, characteristics and advantages. Antenna measurements – radiation pattern measurement, gain measurement and impedance measurement techniques.							

Unit – 5		Radio Wave Propagation			CO5	9
Introduction to radio wave propagation and classification. Ground wave propagation – space waves and surface waves, plane earth reflection and effect of earth curvature. Tropospheric propagation – refraction, radio horizon, duct propagation and tropospheric scattering. Ionospheric propagation – ionospheric layers, reflection and refraction of waves, critical frequency, maximum usable frequency (MUF), skip distance and virtual height. Multi-hop propagation and factors affecting wave propagation.						
					Total Hours	45
Textbooks:						
1	John D Kraus, Ronald J Marhefka, Ahmad S Khan, “Antenna and Wave Propagation”, TataMcGraw Hill, 4th Edition, 2010. (Unit – 1 & 2).					
2	Harish A.R. & Sachidananda M, “Antennas and Wave Propagation”, Oxford University Press, 2007. (Unit – 3 & 4).					
Reference Books:						
1	Constantine A.Balanis, “Antenna Theory: Analysis and Design”, Third Edition, John Wileyand Sons, 2012.					
2	E. C. Jordan & K. G. Balmain, “Electromagnetic Waves and Radiating Systems” PHI Learning, 1968. (Unit – 5).					
Web References:						
1	https://onlinecourses-archive.nptel.ac.in/noc19_ee19/					
2	https://www.mindluster.com/lesson/204842-video					
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 Marks)	(10 Marks)	(60 Marks)
Understand	70 %		40%			
Apply		70%	40%			
Analyze	30%	30%	10%			
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C461.1	3	3	-	2	2							-	
C461.2	3	3	3	2	2							3	
C461.3	3	3	3	2	2							3	
C461.4	3	3	3	2	2							3	
C461.5	3	3	3	2	2							3	

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

Prepared by

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Approved by

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC462	Data Communication Network	PC	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)				
Analog Communication		Digital Communication				
Course Objectives						
1.	To understand the architecture and functions of OSI and TCP/IP models and the basics of computer network topologie					
2.	To study the principles of the data link layer, including random access protocols, flow control, and error control mechanisms.					
3.	To analyze the concepts of the network layer, including switching techniques, routing algorithms, and routing protocols					
4.	To understand the functionality and performance of transport layer protocols and the implementation of congestion control mechanisms.					
5.	To learn the working of various application layer protocols and apply them in designing efficient and reliable communication networks.					
Course Out comes						
Upon completion of the course, students shall have ability to						
C462.1	Interpret OSI and TCP/IP models, basic topologies with emerging computer networks					[U]
C462.2	Apply the appropriate random access protocols, flow and error control schemes to solve the data link layer issues					[AP]
C462.3	Analyze the network layer impairments for switching techniques, routing algorithms and protocols..					[AN]
C462.4	Analyze the performance of transport layer protocols by adopting suitable congestion control schemes.					[AP]
C462.5	Apply the knowledge of application layer protocols to design energy efficient networks					[AP]
Course Contents						
Unit – 1	INTRODUCTION TO NETWORKS					9
Network architecture, Topology, Types (LAN, MAN, WAN &PAN), Network Switching Types:Circuit and packet switching, OSI Reference Model, TCP/IP model, Comparison. Different types of transmission media,Errors in transmission: attenuation, noise, Repeaters						
Unit – 2	DATA LINK LAYER					9
MAC Layer: Aloha, CSMA, CSMA/CD, CSMA/CA protocols, IEEE standards: Ethernet, Token Ring, Bluetooth, Wi-Fi, VLAN, Error detection codes: Parity, CRC, Checksum						
Unit – 3	NETWORK LAYER					9
Internet Protocol,IPv4, IPv6,ARP,DHCP, Inter domain routing, Subnetting, Classless addressing, Network Address Translation.						
Unit – 4	TRANSPORT LAYER					9
Connectionless: UDP, ion Oriented: TCP Connection establishment and termination,flow and congestion control, Noiseless Connect channel:Stop and Wait, Noisy channel: Stop and Wait ARQ, Go back N ARQ, Selective repeat ARQ.						
Unit – 5	APPLICATION LAYER					9
DNS, Electronic Mail: SMTP, POP3, IMAP, Client server &P2P Architecture, HTTP, SNMP						
					Total Hours	45
Textbooks:						

1	Andrew S. Tanenbaum, "Computer Networks", Fifth Edition, Pearson Education India, 2013
2	Ying-Dar Liu, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw-Hill, 2011.
ReferenceBooks:	
1	W Stallings, Cryptography and Network Security, Principles and Practice, 5th Ed., Prentice-Hall, 2010
2	Michael Donahoo, Ken Calvert, Pocket Guide to TCP/IP Socket Programming in C, Morgan Kaufmann Series in Networking, 2000.
Web References:	
1	https://nptel.ac.in/courses/106105183

BLOOM'S TAXONOMY LEVEL	CONTINUOUS ASSESMENT			ASSIGNMENT	ATTENDANCE	END SEMESTER EXAMINATION
	CIA1	CIA2	MODEL			
	6	6	8			
Remember	20%		10%	10	10	60
Understand	80%	10%	40%			
Apply		70%	30%			
Analyze		20%	20%			
Evaluate						
Create				10	10	60
Total(100Marks)	6	6	8			

- 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.

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

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C456.1	3	2		2							2	2	3
C456.2	3	3	2	2							2	2	3
C456.3	3	3	2	2							2	2	3
C456.4	3	3	2	2							2	2	3
C456.5	3	3	2	2							2	2	3

Prepared by
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Approved by
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Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24EC466		Digital Communication	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 Random Processes , Analog Communication			-----				
Course Objectives							
1	To understand the principles of Pulse Code Modulation (PCM) and other digital techniques used for converting analog signals into digital form						
2	To study the characteristics of baseband transmission and analyze intersymbol interference (ISI) using eye pattern analysis.						
3	To learn various digital modulation and demodulation techniques used in modern digital communication systems.						
4	To understand the concepts of source coding and data compression techniques for efficient digital data transmission.						
5	To study channel coding methods for error detection and correction to improve reliability in digital communication systems.						
Course Outcomes							
Upon completion of the course, students will be able to							
C466.1	Elucidate Pulse Code Modulation schemes for digitizing analog signals and apply digital multiplexing concept for different applications						[U]
C466.2	Illustrate the baseband transmission signals with minimum distortion and the level of ISI using eye pattern						[U]
C466.3	Analyze the performance of different digital modulation /demodulation techniques						[AN]
C466.4	Compute the efficiency of source coding for data compression of digital data transmission.						[AP]
C466.5	Apply channel coding for error detection/controlling of digital data transmission						[AP]
Course Contents							
Unit – 1	WAVEFORM CODING				CO1		9+9
Sources and Signals, Basic Signal Processing Operations in Digital Communication, Channels for Digital Communication. Review of Sampling process (Qualitative): Low pass and Band pass sampling, Aliasing, Signal Reconstruction Quantization: Uniform & non uniform quantization, quantization noise, Logarithmic Companding of speech signal Waveform coding: Pulse Code Modulation (PCM), Differential pulse code modulation, Adaptive differential pulse code modulation, Delta modulation							
PRACTICAL:							
1. Pulse Code modulation and demodulation							
2. Differential pulse code modulation modulation and demodulation							
3. Delta modulation and demodulation							
Unit – 2	BASEBAND TRANSMISSION				CO2		9+3
Line codes: Need for line shaping of signals, Properties of Line codes, Power Spectral Density of Unipolar / Polar RZ & NRZ, Bipolar NRZ, Manchester, Matched Filter, Inter symbol Interference, Nyquist criterion for distortion less transmission. Pulse shaping and raised cosine							

filter, Correlative coding, M ary schemes, Eye pattern, Equalization								
PRACTICAL: 1. Line coding schemes								
Unit – 3	CARRIER MODULATION		CO3	9+15				
Signal Representation: Orthogonality, Representation of Signals, Generation and detection of Amplitude Shift Keying (ASK) Modulation, Generation and detection of Frequency Shift Keying (FSK) Modulation, Generation and detection of Binary Phase Shift Keying (BPSK) Modulation, Generation and detection of Quaternary Phase Shift Keying QPSK) and QAM Performance of BPSK, QPSK and QAM in AWGN channel structure of Non-coherent Receivers, Principle of DPSK.								
PRACTICAL: 1. ASK and BFSK Modulation and Demodulation 2. Simulation of ASK, FSK, and BPSK generation schemes 3. Simulation of BER performance of BPSK/QPSK in AWGN and Rayleigh fading channel 4. Simulation of signal constellations of BPSK, QPSK and QAM								
Unit – 4	INTRODUCTION TO INFORMATION THEORY		CO4	9				
Measure of information, entropy. Channel capacity and Shannons theorems, source coding techniques: Prefix code, Huffman Coding, Shannon Fano Coding, Arithmetic Coding, Run length code. Channel capacity, channel coding theorem, Information capacity theorem								
PRACTICAL:-----								
Unit – 5	ERROR CONTROL CODING		CO5	9+3				
Channel coding theorem, Linear Block codes, Hamming codes, Cyclic codes, Convolutional codes, Viterbi Decoder, Turbo Codes.								
PRACTICAL: 1. Simulation of Linear Block and Cyclic error control coding schemes								
Total Theory Hours				45				
Total Practical Hours				30				
Textbooks:								
1	Simon Haykin, Communication Systems, John Wiley & sons, NY, 5th Edition, 2016							
2	B.P. Lathi, Communication Systems, BS Publication, 2004							
Reference Books:								
1	Taub and Schilling, Principles of communication systems, TMH, New Delhi, 4th Edition, 2017							
2	Proakis, J.G., Salehi, M., Digital Communications, 5th Ed., McGraw-Hill International, 2008							
Web References:								
1	https://nptel.ac.in/courses/117101051							
BLOOM'S TAXONOMY LEVEL	ASSESMENT-1			ASSESMENT-2		ASSIGNMENT	ATTENDANCE	END SEMESTER EXAMINATION
	CIA1	CIA2	MODEL	LAB EXPERIMENTS	MODEL LAB EXAM			
	6	6	8	15	5			
	Remember	20%	10%	15	5			
	Understand	80%	10%					
Apply		70%	30%					
Analyze		20%	20%					
					10	10	40	

Evaluate								
Create								
Total(100 Marks)	6	6	8	15	5	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.

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
C466.1	3	2	2		3	2		2	2			2	3
C466.2	3	2	2			2		2	2			2	3
C466.3	3	3	2		3	2		2	2		2	2	3
C466.4	3	3	2								2	2	3
C466.5	3	3	2		3	2		2	2		2	2	3

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

Prepared by
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Approved by
Dr.N.K.Anushkannan HoD/ECE

Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
24EC467	Embedded Systems and IOT Design	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)					
Microcontrollers and Interfacing		-----					
Course Objectives							
1	Understand embedded system design flow, architecture, and programming.						
2	Summarize ARM architecture, instruction set, stacks, subroutines, and peripherals.						
3	Outline real-time systems, task scheduling, multiprocessing, and interprocess communication.						
4	Illustrate IoT architecture, design models, enabling technologies and protocols.						
5	Explain IoT device components, Raspberry Pi, interfaces, and Python programming.						
Course Outcomes							
Upon completion of the course, students will be able to							
C467.1	Explain CPU operation, I/O programming, compilation, and performance.					[U]	
C467.2	Describe the architecture and programming of ARM processor.					[AP]	
C467.3	Explain the basic concepts of real time operating system design					[U]	
C467.4	Apply IoT based system architecture, models, platform design, and communication protocols.					[AP]	
C467.5	Design IoT device design using Raspberry Pi and applications.					[AP]	
Course Contents							
Unit – 1	EMBEDDED SYSTEMS					CO1	9
Embedded System Design Process – Model Train Controller – Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – CPU – Programming Input and Output – Supervisor Mode – Exceptions and Trap – Models for programs – Assembly, Linking and Loading – Compilation Techniques – Program Level Performance Analysis.							
Unit – 2	ARM PROCESSOR AND PERIPHERALS					CO2	31
ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU.							
PRACTICAL:							
1. Experiments using ARM a. Addition of Two Numbers b. Interfacing ADC and DAC c. Blinking of LEDs and LCD d. Interfacing keyboard and Stepper Motor. e. Timer Programming f. UART Serial Communication g. Interrupt Programming							
Unit – 3	PROCESSES AND OPERATING SYSTEMS					CO3	13

Structure of a real – time system – Task Assignment and Scheduling – Multiple Tasks and Multiple Processes – Multirate Systems – Pre emptive real – time Operating systems – Priority based scheduling – Interprocess Communication Mechanisms – Distributed Embedded Systems – MPSoCs and Shared Memory Multiprocessors – Design Example – Audio Player, Engine Control Unit and Video Accelerator.			
<u>PRACTICAL:</u>			
1. Priority Based Task Scheduling using RTOS			
2. Interprocess Communication using Queue in FreeRTOS			
Unit – 4	IOT ARCHITECTURE AND PROTOCOLS	CO4	13
Internet – of – Things – Physical Design, Logical Design – IoT Enabling Technologies – Domain Specific Iots – IoT and M2M – IoT System Management with NETCONF – YANG – IoT Platform Design – Methodology – IoT Reference Model – Domain Model – Communication Model – IoT Reference Architecture – IoT Protocols - MQTT, XMPP, Modbus, CANBUS and BACNet.			
<u>PRACTICAL:</u>			
1. IoT Communication using MQTT Protocol			
2. IoT Device Monitoring using NETCONF and YANG Model			
Unit – 5	IOT SYSTEM DESIGN	CO5	9
Basic building blocks of an IoT device – Raspberry Pi – Board – Linux on Raspberry Pi – Interfaces – Programming with Python – Case Studies: Home Automation, Smart Cities, Environment and Agriculture			
Total Theory Hours			45
Total Practical Hours			30
Textbooks:			
1	Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Third Edition, Morgan Kaufmann, 2012.(Unit –I, II,III)		
2	ArshdeepBahga, Vijay Madisetti, Internet – of- Things – A Hands on Approach, Universities Press, 2015.(Unit – IV,V)		
Reference Books:			
1	Lyla B.Das, “Embedded Systems: An Integrated Approach” Pearson Education, 2013.		
2	Jonathan W.Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, Third Edition Cengage Learning, 2012.		
3	Jane.W.S .Liu, Real – Time Systems, Pearson Education, 2003.		
4			
Web References:			
1	https://onlinecourses.nptel.ac.in/noc26_cs22/course		
2	https://onlinecourses.nptel.ac.in/noc22_cs53/preview		

BLOOM'S TAXONOMY LEVEL	ASSESSMENT-1			ASSESSMENT-2		ASSIGNMENT	ATTENDANCE	END SEMESTER EXAMINATION
	CIA1	CIA2	MODEL	LAB EXPERI MENTS	MODEL LAB EXAM			
	6	6	8	15	5			
Remember	10%	10%	10%				10	40
Understand	60%	60%	60%					
Apply	30%	30%	30%	15%	5%			
Analyze								
Evaluate								
Create								
Total(100 Marks)	6	6	8	15	5	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.

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2
C467.1	3	3	3	3	3				3	3	3	3	3
C467.2	3	3	3	3	3				3	3	3	3	3
C467.3	3	3	3	3	3				3	3	3	3	3
C467.4	3	3	3	3	3				3	3	3	3	3
C467.5	3	3	3	3	3				3	3	3	3	3

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

Prepared by

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC472	Optical and Microwave Engineering	PC	3	0	0	3
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
2024	Theory	VII	-----			
Pre-requisite Course(s)		Co-requisite Course(s)				
Transmission Line and Radiating System. Antenna and wave propagation		-----				
Course Objectives						
1.	To understand the fundamentals of optical fiber communication, including fiber structure, types of optical fibers, and the various losses and dispersion mechanisms.					
2.	To study the operating principles and characteristics of optical sources and detectors used in optical fiber communication systems.					
3.	To learn the properties and applications of S-parameters for analyzing the performance of microwave components.					
4.	To understand and compare the working principles of different solid-state microwave devices used in communication systems.					
5.	To study the measurement techniques and working principles of microwave engineering systems and instruments.					
Course Out comes						
Upon completion of the course, students shall have ability to						
C472.1	Discuss the fundamentals of optical fibers and its different types of losses, dispersion					[U]
C472.2	Explain the concepts of optical light sources and detectors for optical fiber communication					[U]
C472.3	Apply the properties of S parameters to study the characteristics of microwave Components					[AP]
C472.4	Compare the working principle of different solid state based devices.					[U]
C472.5	Demonstrate the working principle and Measurement techniques. of Microwave Engineering					[AP]
Course Contents						
Unit – 1	OPTICAL FIBER FUNDAMENTALS				CO1	9
Evolution of Optic Communications - Basic Optical Laws – Light Propagation in fiber - Fiber Types - Splicing Techniques and Connectors – Attenuation, Absorption, Scattering Losses, Bending Losses, Core and Cladding Losses – Dispersion: Factors Contributing to Dispersion, Group Delay, Material Dispersion, Waveguide Dispersion, Intermodal Dispersion.						
Unit – 2	OPTICAL SOURCES, DETECTORS AND SYSTEMS				CO2	9
Intrinsic and extrinsic material-direct and indirect band gaps-LED structures-Surface emitting LED-Edge emitting LED-quantum efficiency and LED power - light source materials modulation of LED- LASER diodes. Detectors: PIN photo detector, Avalanche photo diodes, Photo detector noise-noise sources - SNR-detector response time- Avalanche multiplication noise-temperature effects on Avalanche Gain						
Unit – 3	HIGH FREQUENCY NETWORK CHARACTERIZATION				CO3	9
Scattering Parameters: Definition, Chain Scattering Matrix, Conversion of S-parameters, Generalized S-parameters and Practical Measurements; S parameter representation of N port networks, properties - S Matrix of a Directional Coupler- waveguide tees and rat race coupler-Qualitative discussion on: Waveguide Corners-Bends- Twists- Matched loads and movable shorts						
Unit – 4	HIGH FREQUENCY SEMICONDUCTOR DEVICES				CO4	9
Gunn-Effect -Gunn Diode- Differential Negative Resistance- Modes of Operation-Amplification- Microwave Generation Read Diode- Physical Description- Avalanche Multiplication IMPATT Diodes- TRAPATT Diode-BARITT Diode-Principles of Operation- Physical Structures.						
Unit – 5	MICROWAVE MEASUREMENTS				CO5	9
Slotted line VSWR measurement- impedance measurement- insertion loss and attenuation measurements-measurement of scattering parameters - Return loss measurement using directional coupler-Introduction to vector network analyzer and its uses- return loss and insertion loss-Measurement of return loss and Insertion						

loss using Spectrum analyzer.

Total Hours | **45**

Textbooks:

1	Gerd Keiser, "Optical Fiber Communication" McGraw -Hill International, 4th Edition. 2010.
2	David M. Pozar, "Microwave Engineering", Third Edition, Wiley India.2012.
3	Annapurna Das and Sisir K Das, "Microwave Engineering", Third edition Tata McGraw Hill Inc., 2009.

ReferenceBooks:

1	John M. Senior, "Optical Fiber Communication", Second Edition, Pearson Education, 2007
2	David M. Pozar, "Microwave Engineering", Third Edition, Wiley India.2012

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	20%		10%	10	10	60
Understand	80%	40%	60%			
Apply		60%	40%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C472.1	3	2	2										2	3
C472.2	3	2	2									2	2	3
C472.3	3	3	3									2	2	2
C472.4	3	2	2									2	2	2
C472.5	3	3	3									2	2	2

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

Prepared by
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Other Department Subject

Department	Course Code	Course	L/T/P
EEE-VI Sem	24EC362	Digital Signal Processing	3/1/0
EEE-VI Sem	24EC367	Microcontrollers and its Applications	3/0/2
CCE,AIML AIDS,CSE-VII Sem	24EC366	Embedded System and Internet of Things	3/0/2

Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
24EC362	Digital Signal Processing	ES	3	1	0	4	
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards				
2024	Analytical	VI	-----				
Pre-requisite Course(s)		Co-requisite Course(s)					
-----		-----					
Course Objectives: The purpose of learning this course is to:							
1	categorize the different types of signals and systems by their properties						
2	extract frequency domain signal using various Fourier transform						
3	acquire knowledge on the necessity of segregation on signals						
4	illustrate the spectrum of sampling, interpolation, and decimation						
Course Outcomes							
Upon completion of the course, students will be able to							
C362.1	Identify the continuous and discrete-time signals and systems					[U]	
C362.2	Apply the concept of DFT for transforming time domain signal to frequency domain signal					[AP]	
C362.3	Apply different techniques in digital IIR filter design for the given set of specifications					[AP]	
C362.4	Analyze the different techniques in digital FIR filter design for the given set of specifications					[AN]	
C362.5	Illustrate the concept of multirate signal processing					[U]	
Course Contents							
Unit – 1	Signals and Systems					CO1	12
Overview of signals and systems, Standard Discrete time signals- Classifications of Discrete time signals, Sampling and Sampling Theorem, Quantization and Coding- Aliasing, Effects of Aliasing -system properties (linearity, time-invariance, memory, causality, BIBO stability) - LTI systems described by linear constant coefficient difference equations (LCCDE) - impulse response and convolution.							
Unit – 2	Discrete Fourier Transform					CO2	12
System representation through differential equations, System representation through difference equations-Realization of discrete time systems: Direct form – I, Direct form – II, Cascade form, Parallel form- Discrete Fourier Transform (DFT), Calculation of DFT-DFT properties: Linearity, Periodicity, Circular convolution, Time reversal, Circular time shift, Parseval’s theorem- DFT using DIT-FFT algorithm Calculation of DFT using DIT-FFT, DFT using DIF-FFT algorithm, Calculation of DFT using DIF-FFT algorithm, Inverse DFT, Calculation of IDFT							
Unit – 3	IIR Filters					CO3	12
Design procedure of Analog Butterworth, Chebyshev Filter- Frequency transformation technique, Need of Pre-warping, Pre- warping- Quantitative treatment of Bilinear transform technique, Impulse invariance technique - Design of IIR Butterworth digital filters using bilinear transform technique and impulse invariant method-. Design of IIR Chebyshev digital filters using bilinear transform technique and Impulse invariant technique-Realization of IIR filters							
Unit – 4	FIR Filters					CO4	12
Design procedure of FIR filter by window technique, Rectangular, Hamming, Hanning and Blackmann Windows, Kaiser window. Design of low pass FIR filter: Calculation of window coefficients, Design of high pass FIR filter: Calculation of filter coefficients, Design of band pass							

FIR filter: Calculation of window coefficients -Design of bandpass FIR filter: Calculation of filter coefficients, Design of band stop FIR filter: Determination of window coefficients, Design of band stop FIR filter: Determination of filter coefficients, Realization of FIR filters: Transversal realization structure, Linear phase realization structure, Polyphase realization structure, Cascade structure.			
Unit – 5	Introduction to Multirate DSP	CO5	12
Introduction -Spectrum of down sampled signal and up-sampled signal- Anti-imaging filter-Identities- Cascading sample rate converter, Transversal structure and Poly phase structure of Decimator, Interpolator., multistage implementation of sampling rate conversion, Implementation of narrow band low pass filter, Filter Banks.			
Total Hours			60
Textbooks:			
1	A. V. Oppenheim and R. W. Schaffer, “Discrete-Time Signal Processing”, Prentice Hall, third edition, 2014.		
2	J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, fourth edition, 2014.		
Reference Books:			
1	S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, second edition, 2021		
2	H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, second edition, 2017.		
Web References:			
1	https://onlinecourses.nptel.ac.in/noc24_ee16/		
2	https://extension.ucsd.edu/courses-and-programs/signals-and-systems		

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%	10%	10	10	60
Understand	50%	30%	40%			
Apply	40%	30%	30%			
Analyze		30%	20%			
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
C362.1	3	2												
C362.2	3	3												
C362.3	3	3									1			
C362.4	3	3									1			
C362.5	3	2									1			

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

Prepared by
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Approved by
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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC366	Embedded Systems and Internet of Things	ES	3	0	2	4
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R24	Embedded Systems	VI	-----			
Pre-requisite Course(s)		Co-requisite Course(s)				
Microprocessors and Microcontrollers						
Course Objectives						
1	To introduce the fundamentals of embedded processors and microcontroller architecture.					
2	To enable students to develop embedded programs using Embedded C.					
3	To provide knowledge on IoT concepts and Arduino based programming.					
4	To familiarize students with IoT communication protocols and open hardware platforms.					
5	To develop the ability to design simple IoT based embedded applications for real-world problems.					
Course Outcomes: Upon completion of the course, students will be able to						
C367.1	Understand architecture and working principles of embedded processors and microcontrollers.					[U]
C367.2	Develop Embedded C programs for basic embedded system operations.					[AP]
C367.3	Apply Arduino programming techniques to interface sensors and actuators.					[AP]
C367.4	Demonstrate IoT communication using different protocols and open platforms.					[AP]
C367.5	Design basic IoT based embedded applications for smart environments.					[AP]
Course Contents						
Unit – 1	8-BIT EMBEDDED PROCESSOR				CO1	9 +6
8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Timers – Serial Communication – Interrupt Handling – Basic Applications of Embedded Processors						
<u>PRACTICAL:</u>						
1. Study the architecture and instruction execution of an 8-bit microcontroller using simulator.						
2. Develop a simple program to generate delay using timer and demonstrate interrupt handling.						
Unit – 2	EMBEDDED C PROGRAMMING				CO2	9+6
Memory and I/O Devices Interfacing – Programming Embedded Systems using C – Data Types and Operators in Embedded C – Need for RTOS – Tasks and Processes – Context Switching – Priority Based Scheduling Policies – Basic RTOS Concepts.						
<u>PRACTICAL:</u>						
1. Write an Embedded C program to blink an LED using delay function.						
2. Implement a simple multitasking concept using scheduling techniques						
Unit – 3	IoT AND ARDUINO PROGRAMMING				CO3	9+6
Introduction to Internet of Things – IoT Devices and Configurations – Basic Components of IoT Systems – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino						

Programming Structure – Digital I/O Programming – Analog Input and PWM Output – Integration of Sensors and Actuators – Introduction to Arduino Shields.			
<u>PRACTICAL:</u>			
1. Interfacing Sensors with Arduino and Raspberry Pi			
2. Implement LED brightness control using PWM in Arduino			
Unit – 4	IoT COMMUNICATION AND OPEN PLATFORMS	CO4	9+6
IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee – GPS and GSM Modules – Introduction to Open Platforms (Raspberry Pi) – Architecture and Programming – Interfacing Devices – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO – Connecting Devices to Cloud Platforms.			
<u>PRACTICAL:</u>			
1. Explore different communication methods with IoT devices (Zigbee, GSM,Bluetooth)			
2. Communicate between Arduino and Raspberry PI using any wireless medium			
Unit – 5	APPLICATION DEVELOPMENT	CO5	9+6
Design Methodology of Embedded Systems – Development of IoT Applications – Home Automation Systems – Smart Agriculture Systems – Smart Cities – Smart Healthcare – Case Studies of IoT Applications.			
<u>PRACTICAL:</u>			
1. Design an IOT based system based on a real time problem statement			
Total Theory Hours			45
Total Practical Hours			30
Textbooks:			
1	Muhammed Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay, “The 8051 Microcontroller and Embedded Systems”, Pearson Education, Second Edition, 2014		
2	Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017.		
Reference Books:			
1	Michael J. Pont, “Embedded C”, Pearson Education, 2007.		
2	Wayne Wolf, “Computers as Components: Principles of Embedded Computer System Design”, Elsevier, 2006.		
3	Andrew N Sloss, D. Symes, C. Wright, “Arm System Developer’s Guide”, Morgan Kauffman/ Elsevier, 2006.		
4	ArshdeepBahga, Vijay Madiseti, “Internet of Things – A hands-on approach”, Universities		
Web References:			
1	https://docs.arduino.cc/tutorials/		

BLOOM'S TAXONOMY LEVEL	ASSESSMENT-1			ASSESSMENT-2		ASSIGNMENT	ATTENDANCE	END SEMESTER EXAMINATION
	CIA1	CIA2	MODEL	LAB EXPERI MENTS	MODEL LAB EXAM			
	6	6	8	10	10	10	10	40
Remember							10	10
Understand	70%		20%					
Apply	30%	100%	80%	10	10	10		
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.

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PSO1	PSO2	PSO3
C367.1	3	1	–	–	1	–	–	–	–	–	1			
C367.2	3	2	1	–	2	–	–	–	–	–	1			
C367.3	2	2	2	1	3	–	–	1	–	–	1			
C367.4	2	2	2	1	3	1	–	1	–	–	1			
C367.5	2	2	3	1	2	1	–	2	1	1	1			

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

Prepared by

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Approved by

Dr.N.K.Anushkannan HoD/ECE

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC367	Microcontrollers and its Applications	ES	3	0	2	4
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R24	Embedded Systems	VI	8085 & 8051 Opcode Sheet			
Pre-requisite Course(s)		Co-requisite Course(s)				
Digital Principles and Computer Organization		---				
Course Objectives						
1	To introduce the fundamentals of microprocessors, microcontrollers, memory organization and embedded systems.					
2	To provide knowledge of the 8085 architecture, instruction set and basic interfacing techniques.					
3	To explain the architecture of the 8051 microcontroller and assembly level programming concepts					
4	To enable programming of 8051 microcontrollers using Embedded C for controlling I/O ports, timers, interrupts and serial communication					
5	To develop the ability to design basic microcontroller-based interfacing systems using peripherals such as LED, seven segment display, LCD, keypad and stepper motor.					
Course Outcomes: Upon completion of the course, students will be able to						
C367.1	Understand the fundamentals of microprocessors, microcontrollers, and memory organization and embedded systems.					[U]
C367.2	Apply 8085 architecture and instruction set to develop simple assembly programs and basic interfacing.					[AP]
C367.3	Understand the 8051 architecture and develop basic assembly level programs					[U]
C367.4	Implement Embedded C programs to control I/O ports, timers, interrupts and serial communication in 8051 microcontrollers					[AP]
C367.5	Design basic microcontroller-based interfacing systems using peripherals such as LED, seven segment display, LCD, keypad and stepper motor for embedded applications.					[AP]
Course Contents						
Unit – 1	INTRODUCTION TO EMBEDDED SYSTEMS AND 8085 ARCHITECTURE				CO1	9+6
Microprocessor vs Microcontroller – Basic components of a microprocessor system – Overview of embedded systems -Functional block diagram of 8085 – Memory interfacing-I/O ports and data transfer concepts – Timing Diagram — Interrupt structure						
PRACTICAL:						
1. Study and analyze the functional block diagram of the 8085 microprocessor, including registers, ALU, program counter, stack pointer, interrupt structure, and timing diagrams using a simulator or development kit.						
Unit – 2	8085 INSTRUCTION SET, PROGRAMMING & INTERFACING				CO2	9+6
Instruction format and addressing modes — Assembly language format — Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing –						

Look up table – Subroutine instructions, stack. Study of Architecture and programming of ICs: 8255, Interfacing Keyboard and Seven segment display, 8254 Timer/Counter			
<u>PRACTICAL:</u>			
1. Write and execute simple 8085 assembly programs for arithmetic operations and data transfer. 2. Interfacing of 8255 Programmable Peripheral Interface with 8085 for keyboard input and seven segment display output			
Unit – 3	INTRODUCTION TO 8051 MICROCONTROLLER	CO3	9 +6
Architecture of 8051 microcontroller – Functional block diagram – Internal RAM and ROM organization – Special Function Registers – Addressing modes – Instruction set – Assembly language programming – Simple programs using loops, counters and delay generation			
<u>PRACTICAL:</u>			
1. Introduction to Microcontroller Kit, and basic arithmetic operation (Addition, Subtraction, Multiplication & Division) ,Sorting of data- a) Ascending order b) Descending order			
Unit – 4	PERIPHERALS AND EMBEDDED C PROGRAMMING	CO4	9 +6
I/O port programming in 8051 – Timer and counter concepts – Timer programming – Interrupt structure and programming – Serial communication basics. Introduction to Embedded C – Structure of Embedded C program–Data types and Time Delays in C – Logic Operations in C – Data conversion in C – Accessing ROM – Data Serialization – I/O programing – Interrupt programming in C			
<u>PRACTICAL:</u>			
1. Embedded C program for 8051 to perform I/O port programming with LED control and generate time delay using timer programming 2. Embedded C program to demonstrate interrupt handling and serial communication (UART) in 8051 for data transmission between microcontroller and PC			
Unit – 5	MICROCONTROLLER INTERFACING AND APPLICATIONS	CO5	9+6
Interfacing concepts – LED and switch interfacing – Seven segment display interfacing – LCD interfacing – Keypad interfacing – Stepper motor interfacing			
<u>PRACTICAL:</u>			
1. Control of stepper motor 2. Interface a 16×2 LCD display with the 8051 microcontroller and write a program to display characters/messages on the LCD			
Total Theory Hours			45
Total Practical Hours			30
Textbooks:			
1	Microprocessor Architecture, Programming and Applications with the 8085 Ramesh S. Gaonkar, Penram International Publishing, 6th Edition / Reprint 2013		
2	The 8051 Microcontroller and Embedded Systems: Using Assembly and C Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay, Pearson Education, 2nd Edition, 2013		
Reference Books:			
1	The 8051 Microcontroller: Architecture, Programming and Applications Kenneth J. Ayala, Cengage Learning, 2nd Edition, 2004		
2	Microprocessors and Interfacing: Programming and Hardware Douglas V. Hall, McGraw-Hill Education, 2nd Edition, 1992		
3	Embedded Systems: Architecture, Programming and Design Raj Kamal, McGraw-Hill Education, 2nd Edition, 2008		

4	Embedded Systems: Introduction to ARM Cortex-M Microcontrollers Jonathan W. Valvano, CreateSpace Independent Publishing, 5th Edition, 2017
Web References:	
1	https://onlinecourses.nptel.ac.in/noc22_ee12/preview

BLOOM'S TAXONOMY LEVEL	ASSESSMENT-1			ASSESSMENT-2		ASSIGNMENT	ATTENDANCE	END SEMESTER EXAMINATION
	CIA1	CIA2	MODEL	LAB EXPERI MENTS	MODEL LAB EXAM			
	6	6	8	10	10			
Remember							10	10
Understand	70%	50%	20%					
Apply	30%	50%	80%	100%	100%	100%		
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.

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2	PSO3
C367.1	3	1	–	–	–	–	–	–	–	–	–			
C367.2	3	2	1	–	1	–	–	–	–	–	–			
C367.3	3	2	1	–	1	–	–	–	–	–	–			
C367.4	2	2	2	1	2	–	–	–	–	–	1			
C367.5	2	2	3	1	2	1	–	1	–	–	1			

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

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24HS171	HUMAN VALUES AND ETHICS		2	0	0	2
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 orient students about value education and human education.					
2	To help them learn concepts of human values and respect for others.					
3	To provide in-depth understanding on the leadership qualities and ethics needed for a professional					
4	To inculcate a sense of ethics in the profession the students take up.					
5	To inculcate basic knowledge about engineering Ethics					
Course Outcomes						
Upon completion of the course, students will be able to						
CS151.1	Understand value education and develop a sense of self respect					[U]
CS151.2	Develop an understanding towards to human values and respect others.					[U]
CS151.3	Acquire ethical and leadership qualities in managing self and others					[U]
CS151.4	Gain clarity on personal and professional ethics					[U]
CS151.5	Understand the core values that shape the ethical behavior of an engineer					[U]
Course Contents						
Unit – 1	VALUE EDUCATION				CO1	6
Value Education: Definition, Concept and Need for Value Education - The Content and Process of Value Education-Self-Exploration as a means of Value Education-Happiness and Prosperity as parts of Value Education						
Unit – 2	HUMAN VALUES				CO2	6
Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality						
Unit – 3	ETHICS & LEADERSHIP QUALITIES				CO3	6
Ethical values: Ethics, Social Ethics, Public Policy - Leadership qualities: Integrity, Character, Courage - Personality development. Inter-culture Tolerance						
Unit – 4	INTRODUCTION TO PROFESSIONAL ETHICS				CO4	6
Basic concepts, Governing Ethics, Personal and Professional Ethics, Ethical Dilemmas, Life Skill, Professional Association, Professional Risks, Professional Accountabilities, Professional Success						
Unit – 5	ENGINEERING ETHICS				CO5	6
The History of Ethics-Purposes for Engineering Ethics-Engineering Ethics- Consensus and Controversy – Professional and Professionalism –Professional Roles to be played by an Engineer–Self Interest, Customs and Religion-Uses of Ethical Theories-Types of Inquiry.						
					Total Hours	30
Textbooks:						
1	Jayasree Suresh and B. S. Raghavan, Human Values and Professional Ethics, 3rd Edition, S. Chand Publications,2009					
2	Mike W Martin and Roland Schinzing, “Ethics in Engineering”, 4th Edition, McGraw-Hill, New York 2017.					
3	Govindarajan M, Natarajan S and Senthil Kumar VS, “Engineering Ethics”, Prentice Hall of India,New Delhi, 2013.					
Reference Books:						
1	P S R Murthy : “Indian Culture, Values and Professional Ethics”. 2nd Edition, B S					

	Publications, Hyderabad. 2013
2	A. Alavudden, R. Kalil Rahaman & M . Jayakumaran : “Professional Ethics & Human Values”, 1st Edition, University Science Press (An Imprint of Laxmi Publications Pvt Ltd., Chennai, Bangalore. 2008
3	Ethics in Engineering” by Mike W. Martin and Roland Schinzinger – Tata McGraw-Hill – 2003.
4	“Engineering Ethics” by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.
Web References:	
1	https://courseware.cutm.ac.in/wp-content/uploads/2020/05/Professional-Ethics-and-Human-Values-by-R.S-NAAGARAZAN.pdf
2	https://www.scribd.com/document/436935802/Engineering-Ethics

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 %	100%	100%			
Apply						
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
C151.1	-	-	-	-	-	-	3	3	-	-	-
C151.2	-	-	-	-	-	-	3	3	-	-	-
C151.3	-	-	-	-	-	-	3	3	-	-	-
C151.4	-	-	-	-	-	-	3	3	3	-	-
C151.5	-	-	-	-	-	-	3	3	3	-	-

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

Prepared by

Approved by

Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
24EC472	Optical and Microwave Engineering	PC	3	0	0	3	
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards				
2024	Theory	VII	-----				
Pre-requisite Course(s)		Co-requisite Course(s)					
Transmission Line and Radiating System. Antenna and wave propagation		-----					
Course Objectives							
6.	To understand the fundamentals of optical fiber communication, including fiber structure, types of optical fibers, and the various losses and dispersion mechanisms.						
7.	To study the operating principles and characteristics of optical sources and detectors used in optical fiber communication systems.						
8.	To learn the properties and applications of S-parameters for analyzing the performance of microwave components.						
9.	To understand and compare the working principles of different solid-state microwave devices used in communication systems.						
10.	To study the measurement techniques and working principles of microwave engineering systems and instruments.						
Course Out comes							
Upon completion of the course, students shall have ability to							
C472.1	Discuss the fundamentals of optical fibers and its different types of losses, dispersion					[U]	
C472.2	Explain the concepts of optical light sources and detectors for optical fiber communication					[U]	
C472.3	Apply the properties of S parameters to study the characteristics of microwave Components					[AP]	
C472.4	Compare the working principle of different solid state based devices.					[U]	
C472.5	Demonstrate the working principle and Measurement techniques. of Microwave Engineering					[AP]	
Course Contents							
Unit – 1	OPTICAL FIBER FUNDAMENTALS					CO1	9
Evolution of Optic Communications - Basic Optical Laws – Light Propagation in fiber - Fiber Types - Splicing Techniques and Connectors – Attenuation, Absorption, Scattering Losses, Bending Losses, Core and Cladding Losses – Dispersion: Factors Contributing to Dispersion, Group Delay, Material Dispersion, Waveguide Dispersion, Intermodal Dispersion.							
Unit – 2	OPTICAL SOURCES, DETECTORS AND SYSTEMS					CO2	9
Intrinsic and extrinsic material-direct and indirect band gaps-LED structures-Surface emitting LED-Edge emitting LED-quantum efficiency and LED power - light source materials modulation of LED- LASER diodes. Detectors: PIN photo detector, Avalanche photo diodes, Photo detector noise-noise sources - SNR-detector response time- Avalanche multiplication noise-temperature effects on Avalanche Gain							
Unit – 3	HIGH FREQUENCY NETWORK CHARACTERIZATION					CO3	9
Scattering Parameters: Definition, Chain Scattering Matrix, Conversion of S-parameters, Generalized S-parameters and Practical Measurements; S parameter representation of N port networks, properties - S Matrix of a Directional Coupler- waveguide tees and rat race coupler-Qualitative discussion on: Waveguide Corners-Bends- Twists- Matched loads and movable shorts							
Unit – 4	HIGH FREQUENCY SEMICONDUCTOR DEVICES					CO4	9
Gunn-Effect -Gunn Diode- Differential Negative Resistance- Modes of Operation-Amplification- Microwave Generation Read Diode- Physical Description- Avalanche Multiplication IMPATT Diodes- TRAPATT Diode-BARITT Diode-Principles of Operation- Physical Structures.							
Unit – 5	MICROWAVE MEASUREMENTS					CO5	9
Slotted line VSWR measurement- impedance measurement- insertion loss and attenuation measurements-measurement of scattering parameters - Return loss measurement using directional coupler-Introduction to vector network analyzer and its uses- return loss and insertion loss-Measurement of return loss and Insertion							

loss using Spectrum analyzer.

Total Hours 45

Textbooks:

- 1 Gerd Keiser, "Optical Fiber Communication" McGraw -Hill International, 4th Edition. 2010.
- 2 David M. Pozar, "Microwave Engineering", Third Edition, Wiley India.2012.
- 3 Annapurna Das and Sisir K Das, "Microwave Engineering", Third edition Tata McGraw Hill Inc., 2009.

ReferenceBooks:

- 1 John M. Senior, "Optical Fiber Communication", Second Edition, Pearson Education, 2007
- 2 David M. Pozar, "Microwave Engineering", Third Edition, Wiley India.2012

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	20%		10%	10	10	60
Understand	80%	40%	60%			
Apply		60%	40%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C472.1	3	2	2									2	3
C472.2	3	2	2								2	2	3
C472.3	3	3	3								2	2	2
C472.4	3	2	2								2	2	2
C472.5	3	3	3								2	2	2

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

Prepared by

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PROFESSIONAL ELECTIVE COURSES (18 Credits)

SL. No.	Course Code	Course Title	L/T/P	Contact hrs./ Wk.
1.	24EC501	ASIC Design	3/0/0	3
2.	24EC502	Low Power VLSI	3/0/0	3
3.	24EC503	Modelling and Synthesis with HDL	3/0/0	3
4.	24EC504	Computer Architecture	3/0/0	3
5.	24EC505	Communication Protocols and Standards	3/0/0	3
6.	24EC506	Embedded C Programming	3/0/0	3
7.	24EC507	Wireless Communication Systems	3/0/0	3
8.	24EC508	Satellite Communication	3/0/0	3
9.	24EC509	Fiber Optic Communication	3/0/0	3
10.	24EC510	Electromagnetic Interference and Compatibility	3/0/0	3
11.	24EC511	Antenna Technologies for Wireless Applications	3/0/0	3
12.	24EC512	Machine Learning for Wireless Communication	3/0/0	3
13.	24EC513	Statistical Signal Processing	3/0/0	3
14.	24EC514	Speech Signal Processing	3/0/0	3
15.	24EC515	Digital Image Processing	3/0/0	3
16.	24EC516	Computer Vision and Its Applications	3/0/0	3
17.	24EC517	Multimedia Compression Techniques	3/0/0	3
18.	24EC518	Wavelets and Its Applications	3/0/0	3
19.	24EC519	Wireless Sensor Networks	3/0/0	3
20.	24EC520	Network and Security	3/0/0	3

21.	24EC521	Software Defined Networks	3/0/0	3
22.	24EC522	Massive MIMO Networks	3/0/0	3
23.	24EC523	4G/5G Communication Networks	3/0/0	3
24.	24EC524	Photonics Networks	3/0/0	3
25.	24EC525	Medical Electronics	3/0/0	3
26.	24EC526	Wearable Devices	3/0/0	3
27.	24EC527	Human Assist Devices	3/0/0	3
28.	24EC528	Medical Imaging Systems	3/0/0	3
29.	24EC529	Brain Computer Interface and Applications	3/0/0	3
30.	24EC530	Body Area Networks	3/0/0	3

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC501	ASIC Design	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)				
CMOS VLSI Design		NIL				
Course Objectives						
1	Understand ASIC design flow and CMOS logic design concepts.					
2	To learn ASIC library design concepts including combinational, sequential, and datapath logic cells.					
3	To study partitioning, floorplanning, placement, and routing techniques in physical design.					
4	To analyze clock design, physical verification, and static timing analysis in ASIC implementation.					
5	To understand System-on-Chip (SoC) design methodologies and bus-based communication architectures.					
Course Outcomes						
Upon completion of the course, students will be able to						
C501.1	Explain ASIC design flow and CMOS logic cell concepts.					[U]
C501.2	Apply partitioning, floor planning, and placement techniques in VLSI design.					[AP]
C501.3	Analyze routing methods and clock network design in ASIC implementation.					[AN]
C501.4	Analyze timing parameters using static timing analysis.					[AN]
C501.5	Describe SoC design flow and bus-based communication architectures.					[AP]
Course Contents						
Unit – 1	INTRODUCTION TO ASICS, CMOS LOGIC AND ASIC LIBRARY DESIGN				CO1	9
Types of ASICs - Design flow - CMOS transistors - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort.						
Unit – 2	PARTITIONING, FLOORPLANNING AND PLACEMENT				CO2	9
Floor Planning Goals and Floor planning tools, I/O and Power planning, Clock planning, Placement Algorithms. Pin Assignment Objectives, Measurement of Delay in floor planning.						
Unit – 3	ROUTING, CLOCK DESIGN AND PHYSICAL VERIFICATION				CO3	9
Routing: Global routing, Detailed routing, Special routing, Clock Design, Clock Network Synthesis. Power and Ground Routing, Watchdog Timer, DRC, RC Extraction, Antenna Effect. Physical verification: Packaging- Layout Issues-Preventing electrical overstress, Static verification techniques-Post-layout design verification						
Unit – 4	STATIC TIMING ANALYSIS				CO4	9
Timing Paths, Time borrowing, Basic concepts of Setup Time and Hold Time, Setup and Hold Violation, Delay – Timing path delay, Interconnect Delay models, Wire load model, Maximum clock frequency, Timing Models, SDF, SDC, Design Constraints- Transition Time, Fanout, Process Variation, Parasitic Extraction						
Unit – 5	SYSTEM-ON-CHIP DESIGN				CO5	9
SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus Based Communication Architectures, High performance filters using delta-sigma modulators. Case Studies: Digital camera, SDRAM, High speed data standards.						
Total Hours						45
Textbooks:						
1	M.J.S.Smith, " Application - Specific Integrated Circuits", Pearson, 2003.					
2	Steve Kilts, “Advanced FPGA Design,” Wiley Inter-Science, August 2007.					
3	Roger Woods, John McAllister, Dr. Ying Yi, Gaye Lightbod, “FPGA-based Implementation of Signal Processing Systems”, Wiley, 2nd Edition, April 2017					

4	Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing", Mc Graw Hill, 1994.
Reference Books:	
1	Douglas J. Smith, "HDL Chip Design", Madison, AL, USA: Doone Publications, 1996.
2	Jose E. France, Yannis Tsividis, "Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994
3	S.Pasricha and N.Dutt, "On-Chip Communication Architectures System on Chip Interconnect", Elsevier, 2008
Web References:	
1	https://www.scribd.com/document/516163687/ASIC-Design-Text-Book

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%	30%			
Apply	60%	80%	70%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C501.1	3	2	2	2	2						1	3	2
C501.2	3	3	2	2	2						1	3	2
C501.3	3	3	2	2	2						1	3	2
C501.4	3	3	2	2	2						1	3	2
C501.5	3	2	2	2	2						1	3	2

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

Prepared by
Ms. M. Thamaraiselvi, AP/ECE

Approved by
Dr.N.K.Anushkannan HoD/ECE

Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24EC502		Low Power VLSI	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)				
CMOS VLSI Design			-----				
Course Objectives							
1	To understand the sources and hierarchy of power dissipation in CMOS VLSI circuits.						
2	To learn power optimization techniques at logic, circuit, gate, and architecture levels.						
3	To study low-power design techniques for combinational circuits, sequential circuits, and memories.						
4	To analyze power estimation methods at circuit, gate, architecture, and behavioral levels.						
5	To understand low-power synthesis methods and software techniques for energy-efficient VLSI design.						
Course Outcomes							
Upon completion of the course, students will be able to							
C502.1	Explain the sources and principles of power dissipation in CMOS circuits.						[U]
C502.2	Apply power optimization techniques at logic, circuit, gate, and architectural levels.						[AP]
C502.3	Design low-power combinational, sequential circuits, and memory systems.						[AP]
C502.4	Analyze power consumption using various power estimation techniques.						[AN]
C502.5	Understand low-power synthesis algorithms and software approaches for energy-efficient systems.						[U]
Course Contents							
Unit – 1		POWER DISSIPATION IN CMOS				CO1	9
Hierarchy of limits of power – Sources of power consumption – Physics of power dissipation in MOS devices – Basic principle of low power design.							
Unit – 2		POWER OPTIMIZATION				CO2	9
Logic level power optimization – Circuit level low power design – Gate level low power design – Architecture level low power design – VLSI subsystem design of low power adders and multipliers.							
Unit – 3		DESIGN OF LOW POWER CIRCUITS				CO3	9
Computer arithmetic techniques for low power system – reducing power consumption in combinational logic, sequential logic, memories – low power clock							
Unit – 4		POWER ESTIMATION				CO4	9
Power Estimation techniques, circuit level, gate level, architecture level, behavioral level, – logic power estimation – Simulation power analysis – Probabilistic power analysis.							
Unit – 5		SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER				CO5	9
Synthesis for low power – Behavioral level transform –Algorithms for low power – software design for low power.							
						Total Hours	45
Textbooks:							
1	Kaushik Roy and S.C.Prasad, “Low power CMOS VLSI circuit design”, Wiley, January 2009						

2	J.B.Kulo and J.H Lou, "Low voltage CMOS VLSI Circuits", Wiley 1999.
3	A.P.Chandrasekaran and R.W.Brodersen, "Low power digital CMOS design", Kluwer, October 2012.

Reference Books:

1	Gary Yeap, "Practical low power digital VLSI design", Kluwer, October 2012.
2	Abdelatif Belaouar, Mohamed.I.Elmasry, "Low power digital VLSI design", Kluwer, September 2012.
3	James B.Kulo, Shih-Chia Lin, "Low voltage SOI CMOS VLSI devices and Circuits", JohnWiley and sons,inc. 2001.
4	J.Rabaey, "Low Power Design Essentials (Integrated Circuits and Systems)", Springer, 2009.

Web References:

1	https://www.udemy.com/course/fundamentals-of-low-power-vlsi-design/
2	

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%	35%			
Apply	40%	60%	65%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C502.1	3	2	1	2	2						1	3	2
C502.2	3	3	2	2	2						1	3	2
C502.3	3	3	3	2	2						1	3	2
C502.4	3	3	2	2	2						1	3	2
C502.5	2	2	2	2	2						1	3	2

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

Prepared by

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Approved by

Dr.N.K.Anushkannan HoD/ECE

Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
24EC503	Modelling and Synthesis With HDL	PE	3	0	0	3	
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards				
R2024	Theory	-----	*****				
Pre-requisite Course(s)		Co-requisite Course(s)					
VLSI Design,Digital Principles and System Design		-----					
Course Objectives							
1	Understand the fundamentals of Hardware Description Languages (HDL)						
2	Model digital systems using VHDL / Verilog constructs.						
3	Design combinational circuits using HDL.						
4	Design sequential circuits using HDL						
5	Understand synthesis concepts and FPGA implementation.						
Course Outcomes							
Upon completion of the course, students will be able to							
C503.1	Discuss HDL design methodology and modelling styles.					[U]	
C503.2	Discuss HDL programs for combinational circuits.					[U]	
C503.3	Apply HDL models for combinational circuits.					[AP]	
C503.4	Apply HDL models for sequential circuits.					[AP]	
C503.5	Discuss synthesis and implement digital circuits on FPGA.					[U]	
Course Contents							
Unit – 1	Introduction to HDL					CO1	9
Introduction to digital design using HDL, overview of VHDL and Verilog, design flow, HDL based design methodology, Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing. Tasks and Functions							
Unit – 2	Levels of modeling					CO2	9
HDL Fundamentals behavioural: Structured procedures, initial and always, blocking and non blocking statements, delay control, generate statement, event control, conditional statements, multiway branching, loops, sequential and parallel blocks. Dataflow: Continuous assignments, delay specification, expressions, operators, operands, operator types and structural: description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays							
Unit – 3	Combinational Circuit Modelling					CO3	9
HDL modelling of combinational circuits such as adders, subtractors, multiplexers, decoders, encoders, comparators, ALU design, hierarchical modelling and parameterized designs.							
Unit – 4	Sequential Circuit Modelling					CO4	9
Flip-flops and latches, registers, counters, shift registers, finite state machines (FSM), synchronous and asynchronous sequential circuits, FSM design using HDL.							
Unit – 5	Synthesis and FPGA Implementation					CO5	9
Concept of logic synthesis, synthesis tools, timing constraints, FPGA architecture basics, design implementation flow, simulation and verification, test bench development.							
Total Hours						45	
Textbooks:							
1	Samir Palnitkar - Verilog HDL, 2nd edition, Pearson Education, 2003.						
2	Michael D Ciletti - Advanced Digital Design with the VERILOG HDL, 2nd Edition, PHI, 2009.						
3	Z Navabi - Verilog Digital System Design, 2nd Edition, McGraw Hill, 2005.						

Reference Books:	
1	Peter J. Ashenden-The Designer's Guide to VHDL ,3 rd Edition,Morgan Kaufmann (Elsevier), 2010.
2	J.Bhaskar – A VHDL Primer,3 rd edition,Prentice Hall of India,2004.
3	Stephen Brown,Zvonkovranesic – Fundamentals of digital logic with Verilog design,2 nd edition,Tata MCGraw-Hill,2008.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc25_cs25/preview
2	https://onlinecourses.nptel.ac.in/noc18_cs48/course

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%	20%			
Apply	60%	20%	20%			
Analyze		60%	60%			
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C503.1	3	2	1	1	1	-	-	-	-	-	-	2	1
C503.2	3	3	2	1	2	-	-	-	-	-	-	3	2
C503.3	3	3	3	1	2	-	-	-	-	-	-	3	3
C503.4	3	3	3	2	3	-	-	-	-	-	-	3	3
C503.5	3	3	3	2	3	-	-	-	-	-	-	3	3

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

Prepared by
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Approved by
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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC504	Computer Architecture	PE	3	0	0	3
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R2024	Theory	----	*****			
Pre-requisite Course(s)		Co-requisite Course(s)				
Digital Principles and System Design		-				
Course Objectives						
1	Understand advanced concepts of computer architecture and parallel processing.					
2	Study pipelining, instruction level parallelism and superscalar architectures.					
3	Learn memory hierarchy design and cache optimization techniques.					
4	Analyze multiprocessor and multicore architectures.					
5	Evaluate performance of modern computer systems.					
Course Outcomes						
Upon completion of the course, students will be able to						
C504.1	Explain advanced processor architecture concepts.					[U]
C504.2	Analyze pipelined processor performance.					[AP]
C504.3	Apply instruction level parallelism techniques.					[AP]
C504.4	Evaluate memory hierarchy and cache design					[AP]
C504.5	Analyze multiprocessor and multicore architectures.					[AN]
Course Contents						
Unit – 1	FUNDAMENTALS OF COMPUTER ARCHITECTURE				CO1	9
Review of computer architecture, performance metrics, instruction set architecture, processor organization, RISC vs CISC architecture, instruction level parallelism.						
Unit – 2	PIPELINING				CO2	9
Basic pipelining concepts, pipeline hazards, data hazards, control hazards, structural hazards, pipeline performance, techniques for pipeline optimization.						
Unit – 3	INSTRUCTION LEVEL PARALLELISM				CO3	9
Superscalar architecture, dynamic scheduling, out-of-order execution, branch prediction techniques, speculative execution.						
Unit – 4	MEMORY HIERARCHY DESIGN				CO4	9
Cache memory organization, cache mapping techniques, cache coherence, virtual memory, memory hierarchy optimization.						
Unit – 5	MULTIPROCESSORS AND MULTICORE SYSTEMS				CO5	9
Parallel processing concepts, shared memory multiprocessors, distributed memory systems, multicore processors, interconnection networks, performance evaluation.						
					Total Hours	45
Textbooks:						
1	John L.Hennessy and David A.Patterson-Computer Architecture:A Quantitative Approach,Morgan Kaufmann/Elseiver,7 th Edition,2025					
2	Kai hwang-Advanced Computer Architecture:parallelism,scalability,programmability,MCGraw-Hill,1993.					
3	Hennessy, J.L., Patterson, D.A., <i>Computer Organization and Design: RISC-V Edition</i> , Elsevier, 2019					
Reference Books:						
1	William Stallings – Computer Organization and Architecture:Designing for					

	performance,Pearson,10 th Edition,2016
2	David E.Culler,Jaswinder Pal Singh and AnoopGupta,Parallel Computer system design:system on Chip,Wiley,2011.
3	Hwang, K., Jotwani, N., <i>Advanced Computer Architecture</i> , McGraw-Hill, 2nd Edition, 2008.
4	John L.Hennessy and David A.Patterson ,Computer organization and design:The Hardware/software Interface,Morgankaufmann/Elseiver,5 th Edition,2014.
Web References:	
1	https://online.courses.nptel.ac.in/noc21-cs47/preview
2	https://online.course.nptel.ac.in/noc21-cs95/preview

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%	20%			
Apply	60%	20%	20%			
Analyze		60%	60%			
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C504.1	3	2	-	-	1	-	-	-	-	-	-	2	1
C504.2	3	3	2	1	2	-	-	-	-	-	-	3	2
C504.3	3	3	3	1	2	-	-	-	-	-	-	3	2
C504.4	3	3	3	2	2	-	-	-	-	-	-	3	2
C504.5	3	3	3	2	2	-	-	-	1	1	-	3	3

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

Prepared by

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Approved by

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Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24EC505		Communication Protocols and Standards	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)				
Embedded Systems and IOT Design			-----				
Course Objectives							
1	To understand the fundamentals of serial and parallel communication protocols used in embedded networking systems.						
2	To study the architecture and working principles of the USB bus for embedded system applications.						
3	To learn the concepts and operation of the CAN bus for reliable communication in embedded and automotive systems.						
4	To understand the principles and structure of Ethernet communication in networking systems.						
5	To apply the concepts of Ethernet communication in embedded applications for efficient data transmission.						
Course Outcomes							
Upon completion of the course, students will be able to							
C505.1	Compare the serial and parallel communication protocol to embedded networking.						[U]
C505.2	Explain USB Bus for embedded systems.						[U]
C505.3	Illustrate the CAN Bus for embedded systems.						[AP]
C505.4	Outline the concepts of Ethernet communication.						[U]
C505.5	Summarize Ethernet communication to embedded applications						[U]
Course Contents							
Unit – 1	SERIAL AND PARALLEL COMMUNICATION					CO1	9
Communication Basics, Serial/Parallel communication: Serial communication protocols –RS232, Synchronous Serial Protocols: Serial Peripheral Interface (SPI), Inter Integrated Circuits (I2C), PC Parallel port communication: ISA/PCI Bus protocols.							
Unit – 2	USB BUS					CO2	9
Introduction to USB – Bus components – USB communication model and framework –Physical and signalling environment – USB Transfer types – USB transactions – error recovery –USB device configuration.							
Unit – 3	CAN BUS					CO3	9
Introduction to CAN bus – CAN standard – CAN controller and bus adapter – device drivers – interaction layer – Protocol Stack implementation and Configuration – CANopen architecture and standards.							
Unit – 4	ETHERNET BASICS					CO4	9
Elements of a network – Inside Ethernet – Building a Network: Hardware options – Cables, Connections and network speed – Design choices: Selecting components –Ethernet Controllers – Using the internet in local and internet communications – Inside the Internet protocol.							
Unit – 5	EMBEDDED ETHERNET					CO5	9
Exchanging messages using UDP and TCP, Serving web pages with Dynamic Data, Serving web pages that respond to user Input , Email for Embedded Systems, Using FTP, Keeping Devices							

and Network secure. Total Hours							
Total Hours						45	
Textbooks:							
1	Frank Vahid, Givargis, “Embedded Systems Design: A Unified Hardware / Software Introduction”, Wiley Publications, 2006						
2	Don Anderson, “Universal Serial Bus System Architecture”, Addison Wesley, 2007						
3	M.Natale, A.Ghosal, “Understanding the CAN Communication Protocol”, Springer, 2012.						
4	Jan Axelson, “Embedded Ethernet and Internet Complete”, Lakeview Research Publisher, 2003.						
Reference Books:							
1	Jan Axelson, “USB Complete”, Lakeview Research Publisher, 2015						
2	Edward Insam, “TCP/IP Embedded Internet Applications”, Newnes Publication, 2003.						
3	D.Paret, “Multiplexed Networks for Embedded Systems”, Wiley Publications, 2007.						
Web References:							
1	https://nptel.ac.in/courses/108105057						
2	https://www.gadgetronicx.com/popular-communication-protocols-embedded-systems/						
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	20%		10	10	60	
	Understand	80%	60%				70%
	Apply		40%				20%
	Analyze						
	Evaluate						
	Create						
Total (100 Marks)	6	6	8	10	10	60	

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C505.1	3	2	1								2	1	3
C505.2	3	2	1								2	1	3
C505.3	3	2	1								2	1	3
C505.4	3	2	1								2	1	3
C505.5	3	2	1								2	1	3

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

Prepared by
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Approved by
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Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
24EC506	Embedded C Programming	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)					
Embedded systems and IOT Design		-----					
Course Objectives							
1	To expose the students to the fundamentals of embedded Programming						
2	To Introduce the GNU C Programming Tool Chain.						
3	To study the basic concepts of embedded C.						
4	To teach the basics of 8051 Programming						
5	To design and implement interfacing applications using 8051 with external devices.						
Course Outcomes							
Upon completion of the course, students will be able to							
C506.1	Explain basic C programming concepts to develop structured programs.					[U]	
C506.2	Understand embedded C programs incorporating real-time constraints and modular design.					[U]	
C506.3	Implement 8051 programming using C for data manipulation, I/O operations, and timing control.					[AP]	
C506.4	Apply serial communication and interrupt programming techniques in 8051 systems.					[AP]	
C506.5	Design and implement interfacing applications using 8051 with peripherals such as ADC, DAC, sensors, LCD, and stepper motors.					[AP]	
Course Contents							
Unit – 1	BASIC C PROGRAMMING					CO1	9
Typical C Program Development Environment - Introduction to C Programming - Structured Program Development in C - Data Types and Operators - C Program Control - C Functions - Introduction to Arrays.							
Unit – 2	EMBEDDED C					CO2	9
Adding Structure to ‘C’ Code: Object-oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.							
Unit – 3	8051 PROGRAMMING IN C					CO3	9
Data types and time delay in 8051, I/O programming in 8051, Logic operations in 8051, Data conversion program in 8051 Accessing code ROM space in 8051, Data serialization using 8051							
Unit – 4	8051 SERIAL PORT AND INTERRUPT PROGRAMMING IN C					CO4	9
Basics of serial communication, 8051 interface to RS232- serial port programming in 8051. 8051 interrupts and programming, Programming for timer configuration.							
Unit – 5	8051 INTERFACING					CO5	9
8051: ADC interfacing, DAC interfacing, Sensor interfacing, LCD interfacing, Stepper motor interfacing.							
Total Hours						45	
Textbooks:							
1	Paul Deitel and Harvey Deitel, “C How to Program”, 9th Edition, Pearson Education Limited, 2022, 1st edition.						

2	Michael J Pont, "Embedded C", Addison-Wesley, An imprint of Pearson Education, 2002.
3	William von Hagen, "The Definitive Guide to GCC", 2nd Edition, Apress Inc., 2006.
4	Gowrishankar S and Veena A, "Introduction to Python Programming", CRC Press, Taylor & Francis Group, 2019
Reference Books:	
1	Noel Kalicharan, "Learn to Program with C", Apress Inc., 2015, 1st edition.
2	Steve Oualline, "Practical C programming", O'Reilly Media, 1997, 3rd edition.
3	Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, 'The 8051 Microcontroller and Embedded Systems' Prentice Hall, 2nd Edition 2007.
4	Myke Predko, "Programming and customizing the 8051 microcontrollers", McGraw Hill 2000, 1st edition
Web References:	
1	https://nptel.ac.in/courses/106105193
2	https://nptel.ac.in/courses/108102045

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	20%	20%	20%	10	10	60
Understand	60%	60%	60%			
Apply	20%	20%	20%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C506.1	3	2	1	1	2	-	-	-	-	-	2	2	2
C506.2	3	3	2	2	3	-	-	-	-	-	2	3	3
C506.3	3	3	2	2	3	-	-	-	-	-	2	3	3
C506.4	3	3	2	2	3	-	-	-	-	-	2	3	3
C506.5	3	3	3	2	3	-	-	-	-	-	2	3	3

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

Prepared by
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Approved by
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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC507	Wireless Communication Systems	PE	3	0	2	4
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
2024	Theory	----	-----			
Pre-requisite Course(s)		Co-requisite Course(s)				
Digital Communication		-----				
Course Objectives						
1	Understand the evolution and fundamental of wireless communication system					
2	Understand the Mobile radio propagation and channel modeling					
3	Understand the different Modulation and Multiple Access Techniques					
4	Understand the Mitigation Techniques and Capacity Analysis					
5	Understand the advanced Wireless technologies					
Course Outcomes						
Upon completion of the course, students will be able to						
C507.1	Explain the evolution and fundamental of wireless communication system					U
C507.2	Identify the Mobile radio propagation and channel modeling					U
C507.3	Explain the different Modulation and Multiple Access Techniques					U
C507.4	Specify the Mitigation Techniques and capacity Analysis					U
C507.5	Explain the advanced Wireless technologies					U
Course Contents						
Unit – 1	Introduction to Wireless Communication Systems				CO1	9
History and evolution of wireless networks (1G, 2G, 3G, 4G LTE, 5G).Wireless application areas (paging, cordless, WLAN, Bluetooth).Fundamental design principles of cellular systems.Cellular concepts: Frequency reuse, handoff strategies, interference, capacity expansion (cell splitting/sectoring)						
Unit – 2	Mobile Radio Propagation and Channel Modeling				CO2	9
Propagation mechanisms: Reflection, diffraction, scattering. Large-scale path loss and shadowing models (Log-normal shadowing, Hata model).Small-scale fading and multipath effects (Rayleigh/Ricean fading).Channel parameters: Coherence time, coherence bandwidth, Doppler spread.						
Unit – 3	Modulation and Multiple Access Techniques				CO3	9
Digital modulation for wireless channels: PSK, QAM, MSK. Multiple Access Techniques: FDMA, TDMA, CDMA (spread spectrum). Orthogonal Frequency Division Multiplexing (OFDM) and OFDMA basics. Peak-to-Average Power Ratio (PAPR) in multicarrier systems.						
Unit – 4	Mitigation Techniques and Capacity Analysis				CO4	9
Equalization: Linear/non-linear equalization, Adaptive equalizers. Diversity Techniques: Time, Frequency, and Space diversity. Channel Coding: Error detection and correction. Capacity of wireless channels (Shannon capacity)						
Unit – 5	Advanced Wireless Technologies				CO5	9
MIMO Systems: Channel modeling, capacity, Space-Time Coding, Beamforming. Smart antennas and Software Defined Radio (SDR). Cognitive radio and spectrum sharing. Wireless LANs and Personal Area Networks (Wi-Fi, Bluetooth).						
Total Hours						45
Textbooks:						
1	Rappaport,T.S.,-Wireless communications”, Pearson Education, Second Edition, 2010					
Reference Books:						

1	Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011
2	David Tse and PramodViswanath, —Fundamentals of Wireless Communication, Cambridge University Press, 2005.
3	UpenaDalal, —Wireless Communication”, Oxford University Press, 2009.
4	Andreas.F. Molisch, —Wireless Communications”, John Wiley – India, 2006.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc21_ee66/preview

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	20%	20%	20%	10	10	60
Understand	80%	80%	80%			
Apply						
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C507.1	3	2	2	3	3	1	-	-	-	-	1	1	3
C507.2	3	3	2	1	3	2	-	-	-	-	-	1	3
C507.3	3	3	3	3	2	2	-	-	-	-	1	1	3
C507.4	2	3	2	2	2	2	-	-	-	-	1	1	3
C507.5	3	3	2	2	2	2	-	-	-	-	1	1	3

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

Prepared by

Mr.R.Nandhakumar AP/ECE

Approved by

Dr.N.K.Anushkannan HoD-ECE

Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
24EC508	Satellite Communication	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 basics of satellite orbits						
2	Understand the satellite segment and earth segment						
3	Understand Link Power budget calculation						
4	Understand the various satellite access and coding technology						
5	Understand the applications of satellite						
Course Outcomes							
Upon completion of the course, students will be able to							
C508.1	Identify the satellite orbits					[U]	
C508.2	Analyze the satellite subsystems					[U]	
C508.3	Evaluate the satellite link power budget					[U]	
C508.4	Identify access technology for satellite					[U]	
C508.5	Identify various satellite applications					[U]	
Course Contents							
Unit – 1	SATELLITE ORBITS					CO1	9
Kepler’s Laws, Newton’s law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse- Sub satellite point – Sun transit outage-Launching Procedures - launch vehicles and propulsion.							
Unit – 2	SPACE SEGMENT					CO2	9
Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders Antenna Subsystem.							
Unit – 3	SATELLITE LINK DESIGN					CO3	9
Basic link analysis, Uplink and Downlink Design equation, Free space loss-Atmospheric effects, Ionospheric scintillation, Rain induced attenuation and interference, system noise temperature, Link Design with and without frequency							
Unit – 4	SATELLITE ACCESS AND CODING TECHNIQUES					C04	9
Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, PAMA and DAMA Assignment Methods, compression – encryption, Coding Schemes.							
Unit – 5	SATELLITE APPLICATIONS					C05	9
INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, LEO, MEO, Satellite Navigational System. GPS-Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).							
Total Hours						45	
Textbooks:							
1	Dennis Roddy, “Satellite Communication”, 4th Edition, Mc Graw Hill International, 2017.						
2	Timothy Pratt, Charles, W.Bostain,Jeremy E.Allnutt,"SatelliteCommunication",3rd Edition, Wiley Publications,2021						
Reference Books:							

1	Tri T. Ha, “Digital Satellite Communications”, 2nd edition, Mc Graw Hill education, 2017
2	Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, “Satellite Communications Systems Engineering”, 2nd edition , Prentice Hall/Pearson , 2013.
3	Bruce R. Elbert, “The Satellite Communication Applications”, Hand Book, Artech House Bostan London, 2003.
4	M.Richharia, “Satellite Communication Systems-Design Principles”, Macmillan, 1999.
Web References:	
1	https://nptel.ac.in/courses/117105131

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	20%	20%	20%	10	10	60
Understand	80%	80%	80%			
Apply						
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C508.1	3	3	3	3	2	3	1	1	-	1	3	3	3
C508.2	3	2	2	3	2	3	-	-	-	-	3	3	3
C508.3	3	3	3	2	1	3	-	-	-	-	3	3	3
C508.4	3	3	2	3	2	3	-	-	-	-	3	3	3
C508.5	3	3	3	3	2	3	-	-	-	-	3	3	3

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

Prepared by
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Approved by
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Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24EC509		Fiber Optic Communication	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)			
Optical Communication & Microwave Engineering				-----			
Course Objectives							
1	To understand the principles of optical sources and photodetectors used in fiber optic communication systems.						
2	To explain the propagation characteristics and parameters of optical fibers.						
3	To analyze the performance of optical communication systems and multiplexing techniques.						
4	To study advanced optical devices such as WDM components, fiber Bragg grating and optical amplifiers.						
5	To understand interference, diffraction and optical measurement techniques used in photonics.						
Course Outcomes							
Upon completion of the course, students will be able to							
C509.1	Understand the operation and characteristics of optical sources and detectors.						[U]
C509.2	Explain the parameters and propagation effects in optical fibers.						[U]
C509.3	Evaluate the performance of optical communication systems using bandwidth and BER concepts.						[AP]
C509.4	Describe the working of wavelength multiplexing devices and optical amplifiers.						[U]
C509.5	Understand the principles of interference, diffraction and optical measurement techniques in photonics.						[U]
Course Contents							
Unit – 1		INTRODUCTION TO OPTICAL FIBERS				CO1	9
Evolution of fiber optic system- Element of an Optical Fiber Transmission link- Ray Optics- Optical Fiber Modes and Configurations. Mode theory of Circular Waveguides- Overview of Modes-Key Modal concepts- Linearly Polarized Modes Single-Mode Fibers							
Unit – 2		SIGNAL DEGRADATION OPTICAL FIBERS				CO2	9
Attenuation, Absorption losses, scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Waveguides-Information Capacity determination. Group Delay-Material Dispersion, Waveguide Dispersion, Polarization Mode dispersion, Intermodal dispersion, Mode Coupling							
Unit – 3		OPTICAL COMMUNICATION SYSTEM ANALYSIS				CO3	9
Fiber optic communication system overview – System bandwidth and bandwidth determination using analog modulation – Bit Error Rate (BER) in fiber optic digital links – Factors affecting system performance – Time Division Multiplexing (TDM) in optical communication.							
Unit – 4		OPTICAL NETWORK COMPONENTS				CO4	9
Principle of Wavelength Division Multiplexing (WDM) – Characteristics of WDM multiplexer and de-multiplexer – Fiber Bragg Grating (FBG): principle and characteristics – Optical circulator: working principle and applications – Erbium Doped Fiber Amplifier (EDFA): principle, characteristics and applications.							
Unit – 5		OPTICAL INTERFERENCE AND DIFFRACTION				CO5	9
Interferometry and determination of refractive index of air – Brewster’s angle and verification of							

Malus law – Fresnel diffraction – Fraunhofer diffraction – Determination of thin film thickness using ellipsometer.	
Total Hours	
45	
Textbooks:	
1	Optical Fiber Communications – Gerd Keiser, McGraw-Hill Education, 5th Edition.
2	Introduction to Fiber Optics – Ajoy Ghatak and K. Thyagarajan, Cambridge University Press / Foundation Books.
Reference Books:	
1	Optical Fiber Communications: Principles and Practice – John M. Senior, Pearson Education.
2	Optical Fiber Communication: Principles and Systems – A. Selvarajan, S. Kar and T. Srinivas, Tata McGraw-Hill.
3	Fiber-Optic Communication Systems – Govind P. Agrawal, Wiley India.
Web References:	
1	https://nptel.ac.in/courses/108106173
2	https://nptel.ac.in/courses/108106190

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	20%	20%	20%	10	10	60
Understand	80%	80%	80%			
Apply						
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C509.1	3	2	2								1		3
C509.2	3	2	2								1		3
C509.3	3	2	2								1		3
C509.4	3	2	2								1		3
C509.5	3	2	2								1		3

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

Prepared by
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Approved by
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Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24EC510		Electromagnetic Interference and Compatibility	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)			
Electromagnetic Fields and Waves				-----			
Course Objectives							
1	To understand the basic concepts of EMI and EMC and their effects on electronic systems.						
2	To study the mechanisms of EMI coupling in electronic circuits and systems.						
3	To learn various EMI control and suppression techniques used in practice.						
4	To understand EMC design practices for circuits and PCBs to reduce interference.						
5	To gain knowledge of EMI measurement techniques and EMC standards used for testing and compliance.						
Course Outcomes Upon completion of the course, students will be able to							
C510.1	Explain the basic concepts of EMI/EMC, sources, victims, emissions, susceptibility, and radiation hazards.						[U]
C510.2	Describe various EMI coupling mechanisms such as conducted, radiated, common mode, differential mode, and transient coupling.						[U]
C510.3	Understand EMI control techniques including shielding, grounding, filtering, bonding, and transient suppression.						[U]
C510.4	Understand EMC design techniques for circuits and PCBs including routing, grounding, decoupling, and cross-talk control.						[U]
C510.5	Explain EMI measurement techniques and relevant international EMC standards used in electronic systems.						[U]
Course Contents							
Unit – 1		EMI/EMC CONCEPTS				CO1	9
EMI-EMC definitions; Sources and Victims of EMI; Conducted and Radiated EMI Emission and Susceptibility; Case Histories; Radiation Hazards to humans.							
Unit – 2		EMI COUPLING PRINCIPLES				CO2	9
Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling; Near field cable to cable coupling; Field to cable coupling; Power mains and Power supply coupling; Transient EMI, ESD.							
Unit – 3		EMI CONTROL				CO3	9
Shielding; EMI Filters; Grounding; Bonding; Isolation transformer; Transient suppressors; EMI Suppression Cables.							
Unit – 4		EMC DESIGN FOR CIRCUITS AND PCBS				CO4	9
Noise from Relays and Switches; Nonlinearities in Circuits; Cross talk in transmission line and cross talk control; Component selection and mounting; PCB trace impedance; Routing; Power distribution decoupling; Zoning; Grounding; VIAs; Terminations.							
Unit – 5		EMI MEASUREMENTS AND STANDARDS				CO5	9
Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Line impedance stabilization networks; EMI Rx and spectrum analyzer; Civilian standards - CISPR, FCC, IEC, EN; Military standards-MIL461E/462.							
Total Hours							45

Textbooks:	
1	V.P.Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press, Newyork, 1996.(Unit I – V)
2	Henry W.Ott., Noise Reduction Techniques in Electronic Systems”, A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 1988. (Unit – IV)
Reference Books:	
1	C.R.Paul,”Introduction to Electromagnetic Compatibility” , John Wiley and Sons, Inc, 1992.
2	Bemhard Keiser, “Principles of Electromagnetic Compatibility”, 3rd Ed, Artech house, Norwood, 1986.
3	Don R. J.White Consultant Incorporate, “Handbook of EMI/EMC”, Vol I-V, 1988.

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	20%	20%	20%	10	10	60
Understand	80%	80%	80%			
Apply						
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C510.1	3	2	2								1		3
C510.2	3	2	2								1		3
C510.3	3	2	2								1		3
C510.4	3	2	2								1		3
C510.5	3	2	2								1		3

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

Prepared by

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Approved by

Dr.N.K.Anushkannan HoD-ECE

Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24EC511		Antenna Technologies for Wireless Applications	PE	3	0	0	3
Regulation		Nature of the Course	Semester	Data Book/Codes/Standards			
2024		Theory and Design	----	-----			
Pre-requisite Course(s)			Co-requisite Course(s)				
Antenna and Wave Propagation			-----				
Course Objectives							
1	To understand the requirements and key antenna parameters such as radiation pattern, gain, bandwidth, and efficiency for wireless applications.						
2	To analyze the radiation characteristics of antennas using EM CAD simulation tools such as ADS.						
3	To design antennas for various wireless applications including RFID, Zigbee, cellular, wearable devices, and UWB communication.						
4	To study and design electrically small antennas using appropriate design principles and techniques.						
5	To analyze the challenges in deployment and implementation of 5G wireless networks, including antenna design considerations.						
Course Outcomes:Upon completion of the course, students will be able to							
C511.1	Understand the requirements of an antenna for wireless applications with respect to its parameters						[U]
C511.2	Analyze the radiation pattern of antennas using EM CAD simulator software-ADS						[AN]
C511.3	Design the antennas for typical applications including RFID, Zigbee, cellular, wearable devices and UWB communication						[AN]
C511.4	Design an electrically small antennas using design principles						[AP]
C511.5	Analyze the challenges associated with the deployment and implementation of 5G networks						[AP]
Course Contents							
Unit – 1		NEAR FIELD APPLICATIONS				CO1	9
Reader antennas- Specifications- gain, bandwidth and polarization, pillar antennas and design. RFID Tag Antennas:Tag architecture- Tag, clip type,Types of Tag, Radio Link, Parameters, Effect of Environment on RFID Tag Antennas. Design of reader and tag antennas							
Unit – 2		HANDSET ANTENNAS				CO2	9
Introduction to handset antenna systems – Design challenges in mobile handset antennas – Performance parameters: gain, efficiency, bandwidth, return loss and SAR – Monopole, PIFA and slot antennas – Multiband and broadband handset antennas – Miniaturization techniques – MIMO antennas for smartphones – Antenna placement and ground plane effects – Antennas for GSM, LTE, 4G and 5G handsets.							
Unit – 3		ANTENNAS FOR INDOOR APPLICATIONS				CO3	9
Zigbee and WLAN: air interface, frequency, Bandwidth and data rate requirement. Specification & topologies, Antennas for Zigbee/WLAN Access points- whip antennas, diversity. Antennas for user equipment- design challenges- gain, efficiency, SAR and size constraints.							
Unit – 4		CELLULAR ANTENNAS				CO4	9
Cellular applications, Performance Requirements, Mode of operation, Base station antennaspecifications and challenges, topologies, Electrically Small Antennas, Topologies- Patch							

arrays, Beam tilting, null fill.							
Unit – 5		ANTENNAS FOR NEXT GENERATION WIRELESS APPLICATIONS				CO5	9
4G & 5G communication, challenges, form factor and broadband performance, Conformal, wearable antennas for body area network and UWB antennas.							
Total Hours							45
Textbooks:							
1	Zhi Ning Chen, Antennas for Portable devices Wiley Publishers, 2007						
2	R.Waterhouse Printed antennas for wireless communications John Wiley Publishers						
Reference Books:							
1	Peter S.Hall, Yang Hao Antennas and propagation for body-centric wireless communications						
2	J.C.Liberti, JR and Theodore Rappaport, Smart Antennas for Wireless communication, Prentice Hall of India, 1999.						
3	John D.Kraus, Ronald J.Marhefka Antennas for all Applications Fourth Edition, Tata McGrawHill, 2006.						
Web References:							
1	https://onlinecourses.nptel.ac.in/noc25_ee109/preview?utm_source=chatgpt.com						
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%	10	10	60	
Understand	40%	40%	40%				
Apply	30%	50%	40%				
Analyze	20%	10%	10%				
Evaluate							
Create							
Total (100 Marks)	6	6	8	10	10	60	

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C511.1	3	3	2		2						2		3
C511.2	3	3	2		2						2		3
C511.3	3	3	2		2						2		3
C511.4	3	3	2		2						2		3
C511.5	3	3	2								2		3

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

Prepared by

Approved by

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Dr.N.K.Anushkannan HoD/ECE

Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24EC512		Machine Learning for Wireless Communication	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 principles of machine learning and apply the fundamental principles for regression and classification						
2	To apply the mathematical principles of probability, linear algebra and optimisation						
3	To apply machine learning principles in the design of some physical layer techniques in wireless communications						
4	To apply machine learning principles in the design of some physical layer techniques in wireless communications						
Course Outcomes							
Upon completion of the course, students will be able to							
C512.1	Apply the principles of machine learning and apply the fundamental principles for regression and classification.						[AP]
C512.2	Apply the linear Modeling approach for estimation of the signal.						[AP]
C512.3	Apply the Bayesian Approach to Machine Learning for channel estimation.						[AP]
C512.4	Apply the machine learning concept for clustering and classification						[AP]
C512.5	Attribute different Machine learning algorithms for wireless applications.						[AP]
Course Contents							
Unit – 1		FUNDAMENTALS OF MACHINE LEARNING				CO1	9
Quick overview of Supervised, Unsupervised and Reinforcement Learning- Supervised LearningClassification, Neural networks and Deep Learning, Unsupervised Learning-Clustering, Autoencoders, Reinforcement Learning-Markov Decision Processes, Q-Learning o Multi-armed Bandits							
Unit – 2		LINEAR MODELING				CO2	9
A Least Squares Approach, Linear modelling, Generalization and over fitting, Regularized least squares A Maximum Likelihood Approach, Errors as noise, Maximum likelihood, Bias-variance trade-off, Effect of noise on parameter estimates.							
Unit – 3		BAYESIAN APPROACH				CO3	9
Exact posterior, Marginal likelihood, Hyperparameters, Bayesian Inference- Non-conjugate models,Point estimate, MAP solution, Laplace approximation							
Unit – 4		CLUSTERING AND CLASSIFICATION				CO4	9
Classification: Probabilistic classifiers, Bayes classifier, logistic regression, Non Probabilistic classifiers, K-nearest neighbors, Discriminative and generative classifiers Clustering: General Problem, K-means clustering, Gaussian mixture models (GMM),EM algorithm , MAP estimates, Bayesian mixture models.							
Unit – 5		APPLICATION IN WIRELESS				CO5	9
Physical layer communications, Use of autoencoders, Modulation, Channel coding, Modulation / Signal classification, Localization, Spectrum Sensing, Adaptive modulation and coding (AMC): classical AMC, using support vector machines, using k-nearest neighbors, using k-means, using							

reinforcement learning			
		Total Hours	45
Textbooks:			
1	Machine Learning and Wireless Communications – Yonina C. Eldar, Cambridge University Press, 2022.		
Reference Books:			
1	M. Bishop Pattern Recognition And Machine Learning, Christopher ,Springer 2009.		
2	P Murphy, MIT Machine Learning A Probabilistic Perspective, Kevin Press 2012		
Web References:			
1	https://nptel.ac.in/courses		

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%	10%	10	10	60
Understand	30%	30%	30%			
Apply	60%	60%	60%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C512.1	3	2	2								2		3
C512.2	3	2	2								2		3
C512.3	3	2	2								2		3
C512.4	3	2	2								2		3
C512.5	3	2	2								2		3

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

Prepared by
Mr.A.Anand AP/ECE

Approved by
Dr.N.K.Anushkannan HoD-ECE

Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
24EC513	Statistical Signal Processing	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)					
Digital Signal Processing		-----					
Course Objectives							
1	To develop a strong foundation in statistical characterization and analysis of discrete random signals and processes.						
2	To understand estimation theory and apply various parameter estimation techniques in signal processing.						
3	To analyze and implement spectrum estimation methods for finite data sequences.						
4	To model signals and design optimal filters using deterministic and stochastic approaches.						
5	To design and analyze adaptive filtering algorithms for real-time signal processing applications.						
Course Outcomes							
Upon completion of the course, students will be able to							
C513.1	Analyze discrete random processes and evaluate statistical measures such as correlation and power spectral density.					[AN]	
C513.2	Apply parameter estimation techniques including ML, MAP, and MMSE for signal processing problems.					[AP]	
C513.3	Implement and compare parametric and non-parametric spectrum estimation methods.					[AP]	
C513.4	Develop signal models and design optimal filters including Wiener and Kalman filters.					[AP]	
C513.5	Design and analyze adaptive filtering algorithms such as LMS and RLS for practical applications.					[AP]	
Course Contents							
Unit – 1	DISCRETE RANDOM SIGNAL PROCESSING					CO1	9
Discrete random processes – Ensemble averages – Wide sense stationary process – Properties - Ergodic process – Sample mean & variance - Auto-correlation and Auto-correlation matrices- Auto covariance and Cross covariance- Properties – White noise process – Wiener Khintchine relation - Power spectral density – Filtering random process – Spectral Factorization Theorem – Special types of Random Processes – AR,MA, ARMA Processes – Yule-Walker equations.							
Unit – 2	PARAMETER ESTIMATION THEORY					CO2	9
Principle of estimation and applications-Properties of estimates-unbiased and consistent estimators, Minimum Variance Unbiased Estimates (MVUE)-Cramer Rao bound- Efficient estimators; Criteria of estimation: Methods of maximum likelihood and its properties; Bayesian estimation: Mean square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation							
Unit – 3	SPECTRUM ESTIMATION					CO3	9
Estimation of spectra from finite duration signals, Bias and Consistency of estimators –non-parametric methods: Periodogram, Modified Periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric Methods: AR, MA and ARMA spectrum estimation - Detection of Harmonic signals - Performance analysis of estimators. MUSIC and ESPRIT algorithms							
Unit – 4	SIGNAL MODELING AND OPTIMUM FILTERS					CO4	9

Introduction- Least square method – Pade approximation – Prony’s method – Levinson Recursion – Lattice filter - FIR Wiener filter – Filtering – Linear Prediction – Non-Causal and Causal IIR Wiener Filter — MSE – State-space model and the optimal state estimation problem, discrete Kalman filter, continuous-time Kalman filter, extended Kalman filter.				
Unit – 5	ADAPTIVE FILTERS		CO5	9
FIR Adaptive filters - Newton's steepest descent method – Widrow Hoff LMS Adaptive algorithm – Convergence – Normalized LMS – Applications: Noise cancellation, channel equalization, echo canceller, Adaptive Recursive Filters: RLS adaptive algorithm, Exponentially weighted RLS-sliding window RLS. Matrix inversion Lemma, Initialization, tracking of non-stationarity.				
Total Hours				45
Textbooks:				
1	Monson. H. Hayes, Statistical Digital Signal Processing and Modelling, John Willey and Sons, 1996			
2	Simon Haykin, Adaptive Filter Theory, Pearson Prentice Hall, 5th edition, 2014			
3	D.G. Manolakis, V.K. Ingle and S.M. Kogon, Statistical and Adaptive SignalProcessing, Artech House Publishers, 2005.			
4	Steven. M. Kay, Modern Spectral Estimation, Theory and Application, Pearson India, 2009			
Reference Books:				
1	A.Veloni, N I. Miridakis, E Boukouvala, Digital and Statistical SignalProcessing, CRC Press, 2019			
2	S Nandi, D Kundu, Statistical Signal Processing- Frequency Estimation, Springer Nature Singapore, 2ndedition, 2020			
3	M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, Statistical Signal Processing with Applications, PHI, 1996			
Web References:				
1	https://nptel.ac.in/courses/108103158?utm_source			

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%	35%			
Apply	40%	60%	65%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C513.1	3	2		2							2	3	3
C513.2	3	3	1	2							2	3	3
C513.3	3	3	2	3	1						2	3	3
C513.4	3	3	3	3	2						2	3	3
C513.5	3	3	3	3	2						2	3	3

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

Prepared by

Ms. M. Thamaraiselvi, AP/ECE

Approved by

Dr.N.K.Anushkannan HoD/ECE

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC514	Speech Signal Processing	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)				
Digital Signal Processing and Its Applications		-----				
Course Objectives						
1	To study the basics of speech signal, speech production mechanisms					
2	To explore time domain and frequency domain analysis of speech signal					
3	To focus on the applications of speech signal processing					
Course Outcomes						
Upon completion of the course, students will be able to						
C514.1	Understand the fundamentals and mechanism of speech signals					[U]
C514.2	Apply time domain methods to extract the speech parameters.					[AP]
C514.3	Apply and analyze frequency domain methods of speech processing					[AP]
C514.4	Apply and analyze the concepts of linear predictive analysis for speech processing					[AP]
C514.5	Attribute the concepts of speech processing for various signal processing models					[AP]
Course Contents						
Unit – 1	MECHANICS OF SPEECH				CO1	9
Speech production mechanism- Nature of Speech signal - Representation of Speech signals - Classification of Speech sounds - Phonetic and Phonemic alphabets - Articulatory features - Auditory perception						
Unit – 2	TIME DOMAIN METHODS FOR SPEECH PROCESSING				CO2	9
Time domain parameters of Speech signal - Methods for extracting the parameters Energy-Average Magnitude - Zero crossing Rate - Silence Discrimination using ZCR and energy						
Unit – 3	FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING				CO3	9
Short Time Fourier analysis - Filter bank analysis - Formant extraction - Pitch Extraction - Analysis by Synthesis- Phase vocoder - Channel vocoder -Formant and Pitch Estimation Speech enhancement						
Unit – 4	LINEAR PREDICTIVE ANALYSIS OF SPEECH				CO4	9
Formulation of Linear Prediction problem in Time Domain -Basic Principle - Auto correlation method - Covariance method - Solution of LPC equations - Durbin's Recursive algorithm - Case study on analyzing customers" buying behavior in retail industries						
Unit – 5	APPLICATION OF SPEECH SIGNAL PROCESSING				CO5	9
Algorithms: Spectral Estimation, dynamic time warping - Hidden Markov model - Pitch Detection -Feature analysis for recognition- Automatic Speech Recognition - Feature Extraction for ASR - Multilanguage text-to-speech conversion						
					Total Hours	45
Textbooks:						

1	Nilanjan Dey, Intelligent Speech Signal Processing, Elsevier Books Inc, 2019
2	Ben Gold and Nelson Morgan “Speech and Audio signal processing- processing and perception of speech and music”, John Wiley and sons 2006
Reference Books:	
1	Quatieri, Discrete-time Speech Signal Processing, Prentice Hall, 2001
2	L.R.Rabiner and R.W. Schaffer., Digital Processing of Speech signals, Prentice Hall, 1978
3	. I.H. Witten, Principles of Computer Speech, Academic Press, 1982
Web References:	
1	https://nptel.ac.in/courses/108103864
2	https://nptel.ac.in/courses/108104866

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	20%	20%	20%	10	10	60
Understand	80%	80%	80%			
Apply						
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C514.1	3	2	2								1		3
C514.2	3	2	2								1		3
C514.3	3	2	2								1		3
C514.4	3	2	2								1		3
C514.5	3	2	2								1		3

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

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Approved by
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Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24EC515		Digital Image Processing	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)				
Digital Signal Processing, Matrices and Calculus			-----				
Course Objectives							
1	To understand the fundamentals of digital images and image acquisition systems						
2	To study image enhancement techniques in spatial and frequency domains						
3	To analyze image restoration and filtering techniques.						
4	To understand segmentation, morphological operations and feature extraction.						
5	To apply modern image processing techniques including compression and deep learning based segmentation.						
Course Outcomes :Upon completion of the course, students will be able to							
C515.1	Explain image representation, acquisition, sampling and quantization concepts						[U]
C515.2	Apply spatial and frequency domain techniques for image enhancement.						[U]
C515.3	Apply restoration models and filtering techniques for degraded images						[AP]
C515.4	Implement segmentation and morphological processing techniques.						[AP]
C515.5	Apply modern applications such as compression and deep learning segmentation models.						[AP]
Course Contents							
Unit – 1	DIGITAL IMAGE FUNDAMENTALS					CO1	9
Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.							
Unit – 2	IMAGE ENHANCEMENT TECHNIQUES					CO2	9
Spatial domain enhancement – Gray level transformations – Histogram equalization – Image smoothing and sharpening – Frequency domain filtering – Ideal, Butterworth and Gaussian filters – Homomorphic filtering – Color image enhancement.							
Unit – 3	IMAGE RESTORATION AND FILTERING					CO3	9
Image degradation model – Noise models – Mean filters – Order statistics filters – Adaptive filters – Inverse filtering – Wiener filtering – Constrained least squares restoration – Introduction to multiresolution techniques.							
Unit – 4	IMAGE SEGMENTATION AND MORPHOLOGICAL PROCESSING					CO4	9
Edge detection – Thresholding – Region based segmentation – Region growing – Region splitting and merging – Morphological operations: erosion, dilation, opening, closing – Watershed segmentation.							
Unit – 5	IMAGE COMPRESSION AND MODERN APPLICATIONS					CO5	9
Need for image compression – Lossless compression (Run length coding, Huffman coding, LZW coding) – Lossy compression (Transform coding, JPEG standard) – Feature extraction – Texture analysis – Introduction to deep learning segmentation models such as U-Net and Mask R-CNN.							

Total Theory Hours	45
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Textbooks:	
1	Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, Pearson Education, Fourth Edition.
2	Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002
Reference Books:	
1	Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
2	Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
3	D.E. Dudgeon and R.M. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990
4	William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002
Web References:	
1	Stanford Image Processing Course. https://web.stanford.edu/class/ee368/index.html
2	OpenCV Image Processing Tutorials: https://docs.opencv.org

BLOOM'S TAXONOMY LEVEL	ASSESSMENT-1			ASSIGNMENT	ATTENDANCE	END SEMESTER EXAMINATION
	CIA1	CIA2	MODEL			
	6	6	8			
Remember					10	60
Understand	50		40			
Apply		50	60	10		
Analyze						
Evaluate						
Create						
Total (100Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C515.1	3	2	-	-	-	-	-	-	-	-	-	3	2
C515.2	3	3	2	1	2	-	-	-	-	-	-	3	3
C515.3	3	3	2	2	2	-	-	-	-	-	-	3	3
C515.4	3	3	3	2	2	-	-	-	-	-	-	2	3
C515.5	2	2	2	2	3	-	-	-	-	-	2	2	3

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

Prepared by
Mr.S.Nithyasai AP/ECE

Approved by
Dr.N.K.Anushkannan HoD/ECE

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC516	Computer Vision and its Applications	PE	3	0	0	3
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
2024	Signal Processing	---	-----			
Pre-requisite Course(s)		Co-requisite Course(s)				
Matrices and Calculus, Digital Image Processing, Digital Signal Processing		---				
Course Objectives						
1	To understand image formation models and geometric transformations used in computer vision.					
2	To study feature detection, matching, and segmentation techniques for visual data analysis.					
3	To analyze motion estimation and feature-based alignment methods used in vision systems.					
4	To understand 3D reconstruction techniques used for recovering scene structure.					
5	To apply deep learning techniques for object detection, recognition, and scene understanding					
Course Outcomes: Upon completion of the course, students will be able to						
C515.1	Explain image formation models, geometric transformations, and filtering methods used in computer vision.					[U]
C515.2	Apply feature detection, matching, and segmentation algorithms for visual analysis.					[U]
C515.3	Apply motion estimation and alignment techniques for multi-view vision systems.					[AP]
C515.4	Implement 3D reconstruction techniques for recovering scene structure and geometry.					[AP]
C515.5	Develop computer vision applications using deep learning methods and standard vision datasets.					[AP]
Course Contents						
Unit – 1	INTRODUCTION TO IMAGE FORMATION AND PROCESSING				CO1	9
Computer Vision – Geometric primitives and transformations – Photometric image formation – The digital camera – Point operators – Linear filtering – Neighbourhood operators – Fourier transforms – Image pyramids and wavelets – Geometric transformations – Global optimization.						
Unit – 2	FEATURE DETECTION, MATCHING AND SEGMENTATION				CO2	9
Points and patches – Edge detection – Line detection – Feature descriptors – Feature matching – Image segmentation – Active contours – Split and merge – Mean shift and mode finding – Normalized cuts – Graph cuts and energy-based segmentation methods.						
Unit – 3	FEATURE-BASED ALIGNMENT AND MOTION				CO3	9
2D and 3D feature-based alignment – Pose estimation – Camera intrinsic calibration – Triangulation – Two-frame structure from motion – Factorization – Bundle adjustment – Constrained structure and motion – Translational alignment – Parametric motion – Optical flow – Layered motion.						
Unit – 4	3D RECONSTRUCTION				O4	9
Shape from X – Active range finding – Surface representations – Point-based representations – Volumetric representations – Model-based reconstruction – Recovering texture maps and albedos.						
Unit – 5	IMAGE RECOGNITION AND MODERN APPLICATIONS				CO5	9
Object detection – Face recognition – Instance recognition – Category recognition – Deep learning for vision – Convolutional Neural Networks – CNN-based feature extraction – Scene understanding – Vision datasets and benchmarking.						
Total Theory Hours						45
Textbooks:						
1	Computer Vision: Algorithms and Applications – Richard Szeliski, Springer, Second Edition, 2022.					
2	Computer Vision: A Modern Approach – David A. Forsyth and Jean Ponce, Pearson Education, Second Edition, 2015.					

3	Pattern Recognition and Machine Learning – Christopher M. Bishop, Springer, 2006.
Reference Books:	
1	Multiple View Geometry in Computer Vision – Richard Hartley and Andrew Zisserman, Cambridge University Press, 2004.
2	Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
3	D.E. Dudgeon and R.M. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990 Computer and Machine Vision – E. R. Davies, Academic Press, Fourth Edition, 2012.
4	William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002
Web References:	
1	https://val.cds.iisc.ac.in/DS-263-VA/project_page/ IISC Bangalore
2	OpenCV Official Documentation https://docs.opencv.org
3	https://szeliski.org/Book/ Richard Szeliski materials
4	Deep Learning for Computer Vision, Stanford https://cs231n.stanford.edu/

BLOOM'S TAXONOMY LEVEL	ASSESSMENT-1			ASSIGNMENT	ATTENDANCE	END SEMESTER EXAMINATION
	CIA1	CIA2	MODEL			
	6	6	8	10	10	40
Remember						
Understand	50		40			
Apply		50	60	10		
Analyze						
Evaluate						
Create						
Total (100Marks)	6	6	8	10	10	60

- 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.

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO 2
C516.1	3	2	–	–	2	–	–	–	–	–	–	3	1
C516.2	2	3	2	2	3	–	–	–	–	–	–	3	2
C516.3	2	3	2	3	2	–	–	–	–	–	–	2	3
C516.4	2	2	3	3	2	–	–	–	–	–	–	2	1
C516.5	2	2	3	2	3	–	–	–	–	–	–	2	2

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

Prepared by
Mr.S.Nithyasai AP/ECE

Approved by
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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC517	Multi Media Compression Technique	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 compression schemes for text, voice, image and video					
2	To understand the QoS issues in multimedia network					
3	To know the communication protocols for multimedia networking					
Course Outcomes :Upon completion of the course, students will be able to						
C517.1	Design audio compression techniques					[AP]
C517.2	Configure Text, image and video compression techniques					[U]
C517.3	Select suitable service model for specific application					[U]
C517.4	Configure multimedia communication network					[U]
Course Contents						
Unit – 1	AUDIO COMPRESSION				CO1	9
Sampling and Quantization of Speech (PCM) - Adaptive differential PCM - Delta Modulation - Vector Quantization- Linear predictive coding (LPC) - Code excited Linear predictive Coding (CELP)						
Unit – 2	IMAGE AND VIDEO COMPRESSION				CO2	9
Graphics Interchange format- Tagged image file format-Digitized documents- Digitized picturesJPEG-Video Encoding-Motion estimation –Overview of H.263 and MPEG-2						
Unit – 3	TEXT COMPRESSION				CO3	9
Static and Dynamic Huffman coding – Arithmetic coding –Lempel-Ziv coding – LZW coding						
Unit – 4	GUARANTEED SERVICE MODEL				CO4	9
Best Effort service model – Scheduling and Dropping policies – Network Performance Parameters – Quality of Service and metrics – WFQ and its variants – Random Early Detection – QoS aware Routing – Admission Control – Resource Reservation – RSVP - Traffic Shaping Algorithms – Caching – Laissez Faire Approach - Possible Architectures – An Overview of QoS Architectures.						
Unit – 5	MULTIMEDIA COMMUNICATION				CO5	9
Stream characteristics for Continuous media – Temporal Relationship – Object Stream Interactions, Media Levy, Media Synchronization – Models for Temporal Specifications – Streaming of Audio and Video – Jitter – Fixed playout and Adaptive playout – Recovering from packet loss – RTSP — Multimedia Communication Standards – RTP/RTCP – SIP and H.263						
Total Hours						45
Textbooks:						
1	Fred Halsall, —Multimedia communication- Applications, Networks, Protocols and Standardsl, Pearson education, 2007.					
Reference Books:						
1	Tay Vaughan, —Multimedia Making it work , McGraw-Hill Osborne Media, 2006.					
2	Kurose and W. Ross, —Computer Networking —A Top Down Approach, Pearson education, 3rd ed, 2005					

3	KR. Rao, Z S Bojkovic, D A Milovanovic, —Multimedia Communication Systems: Techniques, Standards, and Networks, Pearson Education 2007
4	Aura Ganz, Zvi Ganz and Kitti Wongthawaravat, 'Multimedia Wireless Networks: Technologies, Standards and QoS', Prentice Hall, 2003.
Web References:	
1	https://nptel.ac.in/courses/117105083

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	20%	20%	20%	10	10	60
Understand	80%	80%	80%			
Apply						
Analyze						
Evaluate						
Create						
Total(100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C517.1	3	3	3	3	2	3	1	1	-	1	3	3	3
C517.2	3	2	2	3	2	3	-	-	-	-	3	3	3
C517.3	3	3	3	2	1	3	-	-	-	-	3	3	3
C517.4	3	3	2	3	2	3	-	-	-	-	3	3	3
C517.5	3	3	3	3	2	3	-	-	-	-	3	3	3

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

Prepared by
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Approved by
Dr.N.K.Anushkanna HoD/ECE

Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24EC518		Wavelet and its Applications	PE	3	0	0	3
Regulation		Nature of the Course	Semester	Data Book/Codes/Standards			
2024		Theory and analytical	---	-----			
Pre-requisite Course(s)			Co-requisite Course(s)				
Signals and Systems, Digital Signal Processing			-----				
Course Objectives							
1	Understand the limitations of Fourier analysis and the need for time–frequency signal representation						
2	Learn the fundamentals of wavelet theory including Continuous Wavelet Transform (CWT) and Multiresolution Analysis (MRA).						
3	Understand multirate signal processing concepts such as decimation and interpolation.						
4	Study filter bank structures and implement Discrete Wavelet Transform (DWT).						
5	Apply wavelet techniques to signal and image processing applications.						
Course Outcomes							
Upon completion of the course, students will be able to							
C518.1	Explain the limitations of Fourier Transform and the concept of time–frequency analysis.						[U]
C518.2	Understand wavelet basis functions, Continuous Wavelet Transform and Multiresolution Analysis						[U]
C518.3	Analyze multirate signal processing systems including decimation and interpolation.						[AN]
C518.4	Implement Discrete Wavelet Transform using filter bank structures.						[AP]
C518.5	Apply wavelet techniques in applications such as image compression, feature extraction and signal denoising.						[AP]
Course Contents							
Unit – 1		FOURIER ANALYSIS				CO1	9
Fourier basis – Fourier Transform – limitations of Fourier Transform – need for time-frequency analysis – Heisenberg uncertainty principle – Short Time Fourier Transform (STFT) – limitations of STFT – introduction to wavelets and motivation.							
Unit – 2		CONTINUOUS WAVELET TRANSFORM AND MRA				CO2	9
Wavelet basis – Continuous Wavelet Transform (CWT) – scaling function – Multiresolution Analysis (MRA) – important wavelets: Haar, Mexican Hat, Meyer, Shannon and Daubechies wavelets.							
Unit – 3		INTRODUCTION TO MULTIRATE SYSTEMS				CO3	9
Decimation and interpolation in time domain – decimation and interpolation in frequency domain – aliasing and imaging effects – multirate systems for rational sampling factors.							
Unit – 4		FILTER BANKS AND DISCRETE WAVELET TRANSFORM				CO4	9
Two channel filter bank – Perfect Reconstruction (PR) condition – relationship between filter banks and wavelet basis – Discrete Wavelet Transform – wavelet decomposition and reconstruction – filter banks for Daubechies wavelet.							
Unit – 5		APPLICATION				CO5	9

Feature extraction using wavelet coefficients – image compression – signal and image denoising – interference suppression – edge detection – faulty bearing signature identification.	
Total Theory Hours	
45	
Textbooks:	
1	K. P. Soman, K. I. Ramachandran and N. G. Resmi, Insight Into Wavelets: From Theory to Practice, PHI Learning Pvt. Ltd., Third Edition, 2010.
Reference Books:	
1	C. Sidney Burrus, An Introduction to Wavelets, Academic Press, 2014.
2	Stéphane G. Mallat, A Wavelet Tour of Signal Processing: The Sparse Way, Academic Press, Third Edition, 2008.
3	Ingrid Daubechies, Ten Lectures on Wavelets, SIAM Publications, 1992.
Web References:	
1	Stanford Wavelet Tutorial (Stephane Mallat related material) https://web.stanford.edu/class/ee368b/Handouts/wavelet_tutorial.pdf
2	MIT OpenCourseWare – Wavelets and Filter Banks (Lecture Materials) https://ocw.mit.edu/courses/res-6-008-digital-signal-processing-spring-2011/

BLOOM'S TAXONOMY LEVEL	ASSESSMENT-1			ASSIGNMENT	ATTENDANCE	END SEMESTER EXAMINATION
	CIA1	CIA2	MODEL			
	6	6	8			
Remember						
Understand	50		40			
Apply		50	60	10		
Analyze						
Evaluate						
Create						
Total (100Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C518.1	3	2	–	–	–	–	–	–	–	–	1	2	1
C518.2	3	2	–	–	–	–	–	–	–	–	1	2	2
C518.3	3	3	–	1	–	–	–	–	–	–	1	3	2
C518.4	2	3	2	2	1	–	–	–	–	–	1	2	3
C518.5	2	3	2	2	2	–	–	–	–	–	1	2	3

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

Prepared by
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Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
24EC519	Wireless Sensor Networks	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 fundamentals of wireless sensor network						
2	To gain knowledge on the MAC and Routing Protocols of WSN						
3	To get exposed to 6LOWPAN technology						
4	To acquire knowledge on the protocols required for developing real time applications using WSN and 6LOWPAN.						
5	To gain knowledge about operating system related to WSN and 6LOWPAN						
Course Outcomes							
Upon completion of the course, students will be able to							
C519.1	To be able to design solutions for WSNs applications					[AP]	
C519.2	To be able to develop efficient MAC and Routing Protocols					[AP]	
C519.3	To be able to design solutions for 6LOWPAN applications					[AP]	
C519.4	To be able to develop efficient layered protocols in 6LOWPAN					[AP]	
C519.5	To be able to use Tiny OS and Contiki OS in WSNs and 6LOWPAN applications					[AP]	
Course Contents							
Unit – 1	INTRODUCTION					CO1	9
Principle of Wireless Sensor Network -Introduction to wireless sensor networks-Challenges,Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.							
Unit – 2	MAC AND ROUTING PROTOCOLS					CO2	9
MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC,TRAMA, Routing protocols – Requirements, Classification -SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.							
Unit – 3	6LOWPAN					CO3	9
6LoWPAN Architecture - protocol stack, Adaptation Layer, Link layers – Addressing, Routing – MeshUnder - Route-Over, Header Compression - Stateless header compression - Context- based header compression,Fragmentation and Reassembly , Mobility – types, Mobile IPv6, Proxy Home Agent,Proxy MIPv6, NEMO –Routing – MANET, ROLL, Border routing.							
Unit – 4	APPLICATION					CO4	9
Design Issues, Protocol Paradigms -End-to-end, Real-time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP),Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols.							
Unit – 5	TOOLS					CO5	9
TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming							

		Total Hours	45
Textbooks:			
1	Holger Karl, Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley Publication, 2006.		
Reference Books:			
1	Anna Forster, “Introduction to Wireless Sensor Networks”, Wiley, 2017.		
2	Zach Shelby Sensinode and Carsten Bormann, “6LoWPAN: The Wireless Embedded Internet” John Wiley and Sons, Ltd, Publication, 2009.		
Web References:			
1	Philip Levis, “TinyOS Programming”, 2006 –www.tinyos.net.		
2	The Contiki Operating System.http://www.sics.se/contiki.		

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	20%	20%	20%	10	10	60
Understand	50%	50%	50%			
Apply	30%	30%	30%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C519.1	3	2	3	2	2	-	-	-	1	-	1	3	2
C519.2	3	3	2	2	3	-	-	-	1	-	1	3	3
C519.3	3	2	3	2	2	-	-	-	1	-	1	3	2
C519.4	3	3	2	2	3	-	-	-	1	-	1	3	3
C519.5	2	2	2	2	3	-	-	-	1	-	1	2	3

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

Prepared by
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Approved by
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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC520	Network and 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)				
Data Communication		-				
Course Objectives						
1	To introduce the basic concepts of network security fundamentals and threats					
2	To learn the fundamental principles of classical and modern cryptographic techniques for secure communication					
3	To impart technical knowledge indifferent authentication mechanisms and key management techniques used in secure systems					
4	To study and understand the concepts and design network security protocols and defense mechanisms					
5	To learn the concepts of a different hardware security attacks and countermeasures.					
Course Outcomes						
Upon completion of the course, students will be able to						
C520.1	Understand network security fundamentals and threats					[U]
C520.2	Apply classical and modern cryptographic techniques for secure communication					[AP]
C520.3	Understand different authentication mechanisms and key management techniques used in secure systems					[U]
C520.4	Evaluate network security protocols and defense mechanisms					[AN]
C520.5	Understand the different hardware security attacks and countermeasures.					[U]
Course Contents						
Unit – 1	FUNDAMENTALS OF NETWORK SECURITY AND SECURITY THREATS				CO1	9
Introduction to network security and its importance in communication systems. Security goals – confidentiality, integrity, availability and authentication. OSI security architecture. Types of security attacks – passive and active attacks. Security services and mechanisms. Overview of cryptography and network security concepts. Introduction to malware, viruses, worms and basic defense strategies.						
Unit – 2	CRYPTOGRAPHY AND DATA PROTECTION TECHNIQUES				CO2	9
Basic cryptographic techniques and terminology. Symmetric key cryptography – block ciphers and stream ciphers. Data Encryption Standard (DES) and Advanced Encryption Standard (AES). Public key cryptography – RSA algorithm. Key distribution and key management. Hash functions and message authentication. Secure Hash Algorithm (SHA) and Message Authentication Codes (MAC).						
Unit – 3	NETWORK SECURITY PROTOCOLS AND AUTHENTICATION				CO3	9
Authentication principles and digital signatures. Digital Signature Algorithm (DSA). Secure communication protocols – SSL/TLS. Secure e-mail protocols. Network layer security – IP Security (IPSec). Firewalls and intrusion detection systems. Virtual Private Networks (VPN) and						

secure communication techniques.			
Unit – 4	SECURITY IN NETWORK APPLICATIONS	CO4	9
Security issues in web applications and internet services. Secure web communication – HTTPS. Domain Name System security. Email security mechanisms. Wireless network security – WEP, WPA and WPA2. Network monitoring, vulnerability assessment and security management.			
Unit – 5	ADVANCED NETWORK SECURITY AND EMERGING TECHNOLOGIES	CO5	9
Hardware security basics and security vulnerabilities. Hardware Trojans and side-channel attacks. Physical security attacks and countermeasures. Design for security principles. Introduction to blockchain technology and secure distributed systems. Emerging trends in cyber security and network protection.			
Total Hours			45
Textbooks:			
1	William Stallings, Cryptography and Network Security: Principles and Practice, Pearson Education, 2023. (Unit 2)		
2	William Stallings, Network Security Essentials: Applications and Standards, Pearson, 2013		
3	Behrouz A. Forouzan & Debdeep Mukhopadhyay, Cryptography and Network Security, McGraw Hill, 2011. (Unit 1)		
Reference Books:			
1	Bruce Schneier, Applied Cryptography, Wiley, 2015. (Unit-3)		
2	William Cheswick, Steven Bellovin & Aviel Rubin, Firewalls and Internet Security, Addison-Wesley, 2003 (Unit 4 & 5)		
Web References:			
1	https://nptel.ac.in/courses/106105031		
2	https://csrc.nist.gov/projects/cryptographic-standards		

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 Marks)	(10 Marks)	(60 Marks)
Understand	70%	70%	30%			
Apply	30%	30%	30%			
Analyze			20%			
Evaluate			10%			
Create						
Total (100 Marks)	6	6	8	10	10	60

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C520.1	3	3	-	2	2							-	
C520.2	3	3	3	2	2							3	
C520.3	3	3	3	2	2							3	
C520.4	3	3	3	2	2							3	
C520.5	3	3	3	2	2							3	

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

Prepared by
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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC521	Software Defined Networks	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 Communication concepts		-				
Course Objectives						
1	To give a comprehensive exposure to the fundamental concepts and architecture of Software Defined Networking.					
2	To learn various concepts of SDN data plane and OpenFlow protocol					
3	To impart knowledge on SDN control plane architecture and evaluate controller platforms					
4	To explore methods ofSDN control plane architecture and evaluate controller platforms					
5	To understand thenetwork virtualization technologies and SDN integration.					
Course Outcomes:Upon completion of the course, students will be able to						
C521.1	Understand the fundamental concepts and architecture of Software Defined Networking.					[U]
C521.2	Analyze the SDN data plane and OpenFlow protocol					[AN]
C521.3	Analyze the SDN control plane architecture and evaluate controller platforms					[AN]
C521.4	Apply SDN concepts to implement network services					[AP]
C521.5	Understand the network virtualization technologies and SDN integration for modern data center and cloud networking environments					[U]
Course Contents						
Unit – 1	EVOLUTION OF NETWORKING AND SDN FUNDAMENTALS					CO19
Introduction to Traditional Networks – Control Plane, Data Plane and Management Plane – Flow Tables – Limitations of Traditional Networking – Need for Network Simplification – Software Defined Networking concept – SDN Architecture overview – Separation of Control and Data planes – Role of Open Networking Foundation (ONF) – Overview of OpenFlow protocol.						
Unit – 2	SDN DATA PLANE AND OPENFLOW					CO29
SDN Data Plane Architecture – OpenFlow Logical Switch – Flow Tables and Pipeline Processing – Packet Matching and Actions – Group Tables and Meter Tables – OpenFlow Ports and Counters – Flow Entry Management – OpenFlow versions overview – Secure communication between controller and switches.						
Unit – 3	SDN CONTROL PLANE ARCHITECTURE					CO39
SDN Control Plane – Controller Architecture and Functions – Southbound Interfaces – Northbound Interfaces – Controller Platforms – REST APIs in SDN – Coordination among multiple controllers – Network automation and programmability.						
Unit – 4	SDN APPLICATIONS AND NETWORK MANAGEMENT					CO49
SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Network Monitoring and Measurement – Security Applications in SDN – Data Center Networking – Mobility and Wireless Network support – Information-centric networking concepts.						
Unit – 5	NETWORK VIRTUALIZATION AND SDN ECOSYSTEM					CO59
Network Virtualization concepts – Virtual LANs and Virtual Private Networks – Network Function Virtualization (NFV) – NFV Architecture and Infrastructure – Virtualized Network						

Functions – NFV Management and Orchestration – Integration of SDN and NFV – SDN use cases in Data Centers and Wide Area Networks – Software Defined Infrastructure.	
Total Hours	
45	
Textbooks:	
1	Siamak Azodolmolky – Software Defined Networking with OpenFlow, Software Defined Networking with OpenFlow, Packt Publishing.. (Unit 2 and 3)
2	Thomas Nadeau & Ken Gray, Software Defined Networks, O'Reilly Media. (Unit 4 & 5)
3	Paul Goransson & Chuck Black – Software Defined Networks: A Comprehensive Approach . (Unit 1)
Reference Books:	
1	Feamster, Rexford, and Zegura, The Road to SDN: An Intellectual History of Programmable Networks, ACM Queue / SIGCOMM.
2	Kreutz, Ramos, Verissimo, Rothenberg, Azodolmolky&Uhlig, Software-Defined Networking: A Comprehensive Survey, IEEE Proceedings.
Web References:	
1	https://nptel.ac.in/courses/106/106/106106234/
2	https://www.vmware.com/topics/glossary/content/network-virtualization
3	https://sdn.stanford.edu/openflow-tutorial/

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 Marks)	(10 Marks)	(60 Marks)
Understand	70%	30%	40%			
Apply			40%			
Analyze	30%	70%	10%			
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C521.1	3	3	-	2	2								-
C521.2	3	3	3	2	2								3
C521.3	3	3	3	2	2								3
C521.4	3	3	3	2	2								3
C521.5	3	3	3	2	2								3

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

Prepared by
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Approved by
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Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24EC522		Massive MIMO Networks	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)				
Digital Communication, Wireless Communication			-----				
Course Objectives							
1	To learn the concepts of wireless communication fundamentals, OFDM, and MIMO systems basics.						
2	To impart technical knowledge in massive MIMO concepts, advantages, challenges, and spatial channel correlation.						
3	To understand the channel estimation, signal processing, and linear detection/precoding techniques in massive MIMO.						
4	To know about multi-cell massive MIMO systems, inter-cell interference, and pilot contamination issues.						
5	To become familiar with massive MIMO applications in modern wireless networks (5G, LTE-A), deployment scenarios, and future trends.						
Course Outcomes:							
Upon completion of the course, students will be able to							
C522.1	Understand the fundamentals of wireless communication systems, OFDM principles and MIMO channel characteristics used in modern wireless networks.						[U]
C522.2	Analyze the concepts and system models of Massive MIMO systems and favorable propagation.						[AN]
C522.3	Understand the channel estimation techniques and linear signal processing methods for uplink and downlink transmission in Massive MIMO systems.						[U]
C522.4	Understand the multi-cell Massive MIMO networks considering pilot contamination, inter-cell interference and mobility effects.						[U]
C522.5	Apply the deployment and applications of Massive MIMO in LTE-Advanced and 5G wireless networks on spectral and energy efficiency.						[AP]
Course Contents							
Unit – 1	FUNDAMENTALS OF WIRELESS COMMUNICATION AND MIMO					CO1	9
Introduction to Wireless Communication Systems – Single Carrier and Multi-Carrier Transmission – Orthogonality Principles – Orthogonal Frequency Division Multiplexing (OFDM) – Block Diagram of OFDM System – Modulation and Demodulation – Synchronization Issues – Peak-to-Average Power Ratio (PAPR) Problem and Basic Reduction Techniques – Introduction to MIMO Systems – MIMO Channel Model – Antenna Diversity – Channel Capacity in MIMO Systems.							
Unit – 2	PRINCIPLES OF MASSIVE MIMO					CO2	9
Concept and Definition of Massive MIMO – Advantages and Challenges – System Model for Uplink and Downlink – Spatial Channel Correlation – Channel Hardening – Favorable Propagation – Local Scattering Spatial Correlation Models – Basic Performance Benefits of Massive Antenna Arrays.							
Unit – 3	CHANNEL ESTIMATION AND SIGNAL PROCESSING IN MASSIVE MIMO					CO3	9
Uplink Pilots and Channel Estimation – Orthogonal Pilots – Pilot De-spreading – MMSE Channel Estimation – Uplink Data Transmission – Linear Detection Techniques (Maximum Ratio							

Combining, Zero Forcing) – Downlink Transmission – Linear Precoding Techniques (Maximum Ratio Transmission, Zero Forcing) – SINR Analysis – Spectral Efficiency and Power Scaling Laws.			
Unit – 4	MULTI-CELL MASSIVE MIMO SYSTEMS	CO4	9
Multi-Cell Massive MIMO Architecture – Inter-Cell Interference – Pilot Contamination – Non-synchronous Pilot Transmission – Uplink and Downlink Transmission in Multi-Cell Systems – Performance Limits with Large Antenna Arrays – Impact of Mobility and Number of Antennas.			
Unit – 5	MASSIVE MIMO IN MODERN WIRELESS NETWORKS	CO5	9
Massive MIMO in LTE-Advanced and 5G Networks – Beamforming Techniques – Massive MIMO for 5G-NR – Network Deployment Scenarios – Rural Broadband and Dense Urban Networks – Energy Efficiency and Spectral Efficiency Considerations – Future Trends in Massive MIMO Systems.			
Total Hours			45
Textbooks:			
1	Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), “Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency”, Foundations and Trends, Now, 2017. (Unit 1)		
2	Long Zhao, Hui Zhao, Kan Zheng, “Wei Xiang Massive MIMO in 5G Networks: Selected Applications”, Springer 2018. (Unit 4 & 5)		
3	Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, “Fundamentals of Massive MIMO”, Cambridge University Press 2016. (Unit 2 and 3)		
Reference Books:			
1	Andrea Goldsmith, Wireless Communications, Cambridge University Press.		
2	Arogyaswami Paulraj, Rohit Nabar, Dhananjay Gore, Introduction to Space-Time Wireless Communications Cambridge University Press.		
3	Theodore S. Rappaport, Wireless Communications: Principles and Practice, Pearson.		
4	Erik Dahlman, Stefan Parkvall, Johan Skold, 5G NR: The Next Generation Wireless Access Technology Academic Press.		
Web References:			
1	https://nptel.ac.in/courses/108102096		
2	https://www.massivemimo.eu		

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 Marks)	(10 Marks)	(60 Marks)
Understand	70%	30%	30%			
Apply			30%			
Analyze	30%	70%	20%			
Evaluate			10%			
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C522.1	3	3	-	2	2							-	
C522.2	3	3	3	2	2							3	
C522.3	3	3	3	2	2							3	
C522.4	3	3	3	2	2							3	
C522.5	3	3	3	2	2							3	

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

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Approved by

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Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
24EC523	4G / 5G Communication Networks	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)					
Digital Communication, Computer Networks		-					
Course Objectives							
1	To introduce the5G evolution and architecture						
2	To provide necessary basic concepts in5G architecture and radio.						
3	To familiarize the concepts of the processes associated with 5G architecture.						
4	To know the concepts of spectrum sharing and spectrum trading.						
5	To learn the concepts of security features in 5G networks.						
Course Outcomes							
Upon completion of the course, students will be able to							
C523.1	Understand 5G evolution and architecture					[U]	
C523.2	Understand 5G architecture and radio.					[U]	
C523.3	Apply the processes associated with 5G architecture.					[AP]	
C523.4	Understand spectrum sharing and spectrum trading.					[U]	
C523.5	Understand security features in 5G networks.					[U]	
Course Contents							
Unit – 1	THE JOURNEY TO 5G: EVOLUTION OF WIRELESS NETWORK					CO1	9
Evolution of Wireless Networks (2G to 4G); Limitations of 4G; Key performance requirements for 5G; 4G vs. 5G comparative analysis; Simplified Next-Generation Core (NG-Core) concepts.							
Unit – 2	5G ARCHITECTURE & NEW RADIO					CO2	9
Overview of 5G System Architecture; Introduction to 5G New Radio (NR); Cloud-RAN and Virtualized EPC (vEPC); Basics of Radio Access Technologies (RATs).							
Unit – 3	KEY 5G TECHNOLOGIES & PROTOCOLS					CO3	9
Network Slicing fundamentals; Multi-access Edge Computing (MEC); Essentials of 5G Protocols (NAS and NGAP); Service continuity and edge computing benefits.							
Unit – 4	SPECTRUM & WAVE MANAGEMENT					CO4	9
Millimeter Wave (mmWave) characteristics; Cognitive Radio basics; Simple Spectrum Sharing and Trading; Mobility management in high-frequency bands.							
Unit – 5	SECURITY & QUALITY OF SERVICE					CO5	9
5G Security Architecture (User and Network) Flow-based QoS Framework; Overview of common 5G threats and basic mitigation strategies.							
Total Hours						45	
Textbooks:							
1	5G Core networks: Powering Digitalization , Stephen Rommer, Academic Press,2019 (Unit -1)						
2	Wireless Communications: Principles and Practice by Theodore S. Rappaport , Cambridge University Press, 2024 (Unit -1 and 2)						
3	5G System Design: Architectural Perspectives by Patrick Marsch, Ömer Bulakci, Olav Queseth, Mauro Boldi, Wiley, 1st edition, 2018 (Unit -3 and 4)						
4	Network Slicing for 5G and Beyond Networks, S. M. Ahsan Kazmi (Author), Latif U. Khan (Author), Nguyen H. Tran ,Springer , May 2019. (Unit -5)						

Reference Books:	
1	An Introduction to 5G Wireless Networks : Technology, Concepts and Use cases, Saro Velrajan, First Edition, 2020.
2	5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen, Copyrighted Material.
Web References:	
1	https://nptel.ac.in/courses/108105134
2	https://youtu.be/SbYltPawklg
3	https://www.3gpp.org/specifications

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	20%		10%	(10 Marks)	(10 Marks)	(60 Marks)
Understand	80%	30%	40%			
Apply		70%	40%			
Analyze			10%			
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C523.1	3	3	-	2	2							-	
C523.2	3	3	3	2	2							3	
C523.3	3	3	3	2	2							3	
C523.4	3	3	3	2	2							3	
C523.5	3	3	3	2	2							3	

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

Prepared by

Dr.L.Jubair Ahemed ASP/ECE

Approved by

Dr.N.K.Anushkannan HoD/ECE

Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24EC524		Photonic Networks	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 fundamental components and propagation characteristics of optical communication systems.						
2	To study the architecture and operation of optical networks including SONET/SDH and broadcast networks.						
3	To learn the principles of wavelength routing, optical network nodes, and traffic grooming techniques.						
4	To analyze photonic packet switching techniques and optical access network architectures.						
5	To understand transmission system engineering and network management in optical networks.						
Course Outcomes:Upon completion of the course, students will be able to							
C524.1	Explain the propagation characteristics of optical fibers and the operation of optical system components.						[U]
C524.2	Describe different optical network architectures including SONET/SDH and broadcast networks.						[U]
C524.3	Analyze wavelength routing mechanisms and traffic grooming techniques in optical networks.						[U]
C524.4	Explain photonic packet switching methods and optical access network architectures.						[U]
C524.5	Apply transmission system engineering concepts and network management functions in optical networks.						[U]
Course Contents							
Unit – 1		OPTICAL SYSTEM COMPONENTS				CO1	9
Light Propagation in optical fibers – Loss & bandwidth, System limitations, Nonlinear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.							
Unit – 2		OPTICAL NETWORK ARCHITECTURES				CO2	9
Introduction to Optical Networks; SONET / SDH, Metropolitan-Area Networks, Layered Architecture; Broadcast and Select Networks – Topologies for Broadcast Networks, MediaAccess Control Protocols, Wavelength Routing Architecture.							
Unit – 3		WAVELENGTH ROUTING NETWORKS				CO3	9
The optical layer, Optical Network Nodes, Routing and wavelength assignment, Traffic Grooming in Optical Networks, Architectural variations- Linear Light wave networks, Logically Routed Networks.							
Unit – 4		PACKET SWITCHING AND ACCESS NETWORKS				CO4	9
Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronization, Broadcast OTDM networks, Switch-based networks, Contention Resolution Access Networks – Network Architecture overview, Optical Access Network Architectures and OTDM networks.							
Unit – 5		NETWORK DESIGN AND MANAGEMENT				CO5	9

Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion, Wavelength stabilization, Overall design considerations, Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.						
Total Hours						45
Textbooks:						
1	RajivRamaswami and Kumar N. Sivarajan – Optical Networks: A Practical Perspective, Morgan Kaufmann Publishers, 3rd Edition, 2010.					
Reference Books:						
1	Govind P. Agrawal – Fiber-Optic Communication Systems, Wiley India, 4th Edition, 2012.					
2	C. Siva Ram Murthy and Mohan Gurusamy – WDM Optical Networks: Concepts, Design and Algorithms, Prentice Hall of India, 2002.					
3	Gerd Keiser – Optical Fiber Communications, McGraw Hill Education, 5th Edition, 2013.					
Web References:						
1	https://nptel.ac.in/courses/108108174					
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	20%	20%	10	10	60
	Understand	80%	80%			
	Apply					
	Analyze					
	Evaluate					
	Create					
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C524.1	3	2	2								1		3
C524.2	3	2	2								1		3
C524.3	3	2	2								1		3
C524.4	3	2	2								1		3
C524.5	3	2	2								1		3

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

Prepared by
Mr.N.Gopi,AP/ECE

Approved by
Dr.N.K.Anushkannan,AP/ECE

Course Code		Course Name	Category	Hours/Week			C
				L	T	P	
24EC525		Medical Electronics	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)				
Image Processing			-----				
Course Objectives							
1	Explain the generation, characteristics, and recording methods of bio-electrical physiological signals using electrodes and amplifiers.						
2	Explain the measurement techniques of non-electrical physiological and biochemical parameters using biomedical instruments.						
3	To study about the various assist devices used in the hospitals						
4	To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques						
5	To understand the generation of X-ray and its uses in Medical imaging.						
Course Outcomes							
Upon completion of the course, students will be able to							
C525.1	Know the human body electro- physiological parameters and recording of bio-potentials.						[U]
C525.2	Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.						[U]
C525.3	Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators						[U]
C525.4	Comprehend physical medicine methods eg. Ultrasonic, shortwave, microwave surgical diathermies,and bio-telemetry principles and methods.						[U]
C525.5	Know about recent trends in medical instrumentation.						[U]
Course Contents							
Unit – 1		ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING				CO1	9
Sources of bio medical signals, Bio-potentials, Biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics.							
Unit – 2		BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT				CO2	9
PH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.							
Unit – 3		ASSIST DEVICES				CO3	9
Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems.							
Unit – 4		PHYSICAL MEDICINE AND BIOTELEMETRY				CO4	9
Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry.							
Unit – 5		RECENT TRENDS IN MEDICAL INSTRUMENTATION				CO5	9
Telemedicine, Insulin Pumps, Radio pill, Endomicroscopy, Brain machine interface, Lab on a chip.							
Total Hours							45
Textbooks:							

1	Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2007. (UNIT I – V)
Reference Books:	
1	Khandpur, R.S., “Handbook of Biomedical Instrumentation”, TATA Mc Graw-Hill, New Delhi, 2003.
2	John G.Webster, “Medical Instrumentation Application and Design”, 3rd Edition, Wiley India Edition, 2007
3	Joseph J.Carr and John M.Brown, “Introduction to Biomedical Equipment Technology”, John Wiley and Sons, New York, 2004
Web References:	
1	https://nptel.ac.in/courses/112104029

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	20%	20%	20%	10	10	60
Understand	80%	80%	80%			
Apply						
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C525.1	3	2	1	2	2	-	-	-	-	-	1	3	2
C525.2	3	2	1	2	3	-	-	-	-	-	1	3	3
C525.3	3	2	2	2	2	-	-	-	-	-	1	3	2
C525.4	3	2	2	2	2	-	-	-	-	-	1	3	2
C525.5	2	2	1	1	2	-	-	-	-	-	1	2	2

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

Prepared by
Mrs.S, Sanjula AP/ECE

Approved by
Dr.N.K.Anushkannan HoD/ECE

Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
24EC526	Wearable Devices	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 The student should be made to							
1	Understand the basic concepts of wearable systems and sensors						
2	Understand sensor and power requirements						
3	Study about BAN and wireless communication technique						
4	Study the various types of smart textile						
5	Study about applications of wearable systems						
Course Outcomes: Upon completion of the course, students will be able to							
C526.1	Understand the concept of both wearable systems and sensors.					[U]	
C526.2	Understand about Signal processing and the requirements of energy harvesting for wearable devices.					[U]	
C526.3	Understand the concept of Body Area Network and the wireless communication technique					[U]	
C526.4	Apply the concept of Smart textile for monitoring various biomedical parameters.					[AP]	
C526.5	Apply various wearable systems in the biomedical applications.					[AP]	
Course Contents							
Unit – 1	INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS					CO1	9
Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor.							
Unit – 2	SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES					CO2	9
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.							
Unit – 3	WIRELESS HEALTH SYSTEMS					CO3	9
Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.							
Unit – 4	SMART TEXTILE					CO4	9
Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study- smart fabric for monitoring biological parameters - ECG, respiration.							
Unit – 5	APPLICATIONS OF WEARABLE SYSTEMS					CO5	9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.						
Total Hours						45
Textbooks:						
1	Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011					
2	Zhang and Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013					
3	Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014					
4	Mehmet R. Yuce and Jamil Y. Khan, Wireless Body Area Networks Technology, Implementation applications, Pan Stanford Publishing Pte.Ltd, Singapore, 2012					
Reference Books:						
1	Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.					
2	Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.					
Web References:						
1	Coursera titled “Wearable Technologies and Sports Analytics”					
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	20			
Apply	80	80	80			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C526.1	3	2	1	2							1	2	2
C526.2	3	2	1	2							1	2	2
C526.3	3	2	1	2							1	2	2
C526.4	3	2	1	2							1	2	2
C526.5	3	2	1	2							1	2	2

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

Prepared by
Dr.N.K.Anushkannan HOD/ECE

Approved by
Dr.N.K.Anushkannan HoD/ECE

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC527	Human Assist Devices	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 The student should be made to						
1	Study about Heart Lung Machine and Artificial Heart					
2	Study about various cardiac assist devices					
3	Learn about artificial kidney					
4	Study the wearable devices for respiratory function and hearing loss					
5	Study about recent techniques used in modern clinical applications					
Course Outcomes						
Upon completion of the course, students will be able to						
C527.1	Understand about principles and construction of artificial heart					[U]
C527.2	Understand various mechanical techniques that improve therapeutic technology					[U]
C527.3	Explain the functioning of the membrane or filter that cleanses the blood					[U]
C527.4	Identify tests to assess the hearing loss and development of wearable devices					[AP]
C527.5	Apply various techniques for rehabilitation and physiotherapy					[AP]
Course Contents						
Unit – 1	HEART LUNG MACHINE AND ARTIFICIAL HEART				CO1	9
Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle.						
Unit – 2	CARDIAC ASSIST DEVICES				CO2	9
Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra-Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques.						
Unit – 3	ARTIFICIAL KIDNEY				CO3	9
Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney and Implanting Type.						
Unit – 4	RESPIRATORY AND HEARING AIDS				CO4	9
Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.						
Unit – 5	RECENT TRENDS				CO5	9
Transcutaneous electrical nerve stimulator, bio-feedback, Diagnostic and point-of-care platforms.						
Total Hours						45
Textbooks:						
1	Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering –MarcelDekkerInc New York 2004.					
2	John. G. Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004					

3	Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006.					
Reference Books:						
1	Andreas. F.Vonracum, “Hand book of bio material evaluation”, Mc-Millan publishers, 1980.					
2	Gray E Wnek, Gray L Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering”Marcel DekkerInc New York 2004.					
3	D.S. Sunder, “Rehabilitation Medicine”, 3rd Edition, Jaypee Medical Publication, 2010.					
Web References:						
1	Ulektzskills courseon Human Assist Devices					
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	80			
	Analyze					
	Evaluate					
	Create					
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C527.1	3	2	1	2							1	2	2
C527.2	3	2	1	2							1	2	2
C527.3	3	2	1	2							1	2	2
C527.4	3	2	1	2							1	2	2
C527.5	3	2	1	2							1	2	2

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

Prepared by

Dr.N.K.Anushkannan HOD/ECE

Approved by

Dr.N.K.Anushkannan HoD/ECE

Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
24EC528	Medical Imaging Systems	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)					
Image Processing		-					
Course Objectives							
1	To understand the generation of X-ray and its uses in Medical imaging.						
2	To describe the principle of Computed Tomography.						
3	To know the techniques used for visualizing various sections of the body.						
4	To learn the principles of different radio diagnostic equipment in Imaging.						
5	To discuss the radiation therapy techniques and radiation safety.						
Course Outcomes: Upon completion of the course, students will be able to							
C528.1	Describe the working principle of the X-ray machine and its application.					[U]	
C528.2	Illustrate the principle computed tomography					[U]	
C528.3	Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.					[U]	
C528.4	Demonstrate the applications of radionuclide imaging.					[U]	
C528.5	Apply different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety.					[AP]	
Course Contents							
Unit – 1	X RAYS					CO1	9
Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography - discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.							
Unit – 2	COMPUTED TOMOGRAPHY					CO2	9
Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques – back projection and iterative method.							
Unit – 3	MAGNETIC RESONANCE IMAGING					CO3	9
Fundamentals of magnetic resonance- properties of electromagnetic waves : speed , amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.							
Unit – 4	NUCLEAR IMAGING					CO4	9
Radioisotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera – Principle of operation, collimator and photomultiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET							
Unit – 5	RADIATION THERAPY AND RADIATION SAFETY					CO5	9
Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in							

radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles

Total Hours | **45**

Textbooks:

1	Isaac Bankman, I. N. Bankman , Handbook Of Medical Imaging: Processing and Analysis(Biomedical Engineering),Academic Press,2000
2	Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis , SPIE Press 2000
3	Khin Wee Lai, DyahEkashantiOctorinaDewi “Medical Imaging Technology”, Springer Singapore, 2015

Reference Books:

1	Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw – Hill, New Delhi, 2003.
2	Dougherty, Geoff (Ed.), “Medical Image Processing - Techniques and Applications “,Springer-Verlag New York, 2011

Web References:

1	https://onlinecourses.nptel.ac.in/noc21_bt50/preview
2	https://onlinecourses.nptel.ac.in/noc22_bt34/preview

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	20%	20%	20%	10	10	60
Understand	80%	80%	70%			
Apply			10%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C528.1	3	2	1	2	2	2			1		1	3	2
C528.2	3	2	1	2	3	2			1		1	3	2
C528.3	3	2	2	2	3	2			1		1	3	2
C528.4	3	2	2	2	2	3			1		1	3	2
C528.5	3	3	3	2	3	3			1		2	3	3

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

Prepared by
Dr.N.K.Anushkannan HOD/ECE

Approved by
Dr.N.K.Anushkannan HoD/ECE

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24EC529	Brain Computer Interface And Applications	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						
The student should be made to						
1	Understand the basic concepts of brain computer interface (BCI)					
2	Study the various electrophysiological sources					
3	Study the various feature extraction methods					
4	Study the various feature translation methods					
5	Study about applications of BCI					
Course Outcomes						
Upon completion of the course, students will be able to						
C529.1	Explain BCI system and its potential applications					[U]
C529.2	Explain various potentials and its neural activity.					[U]
C529.3	Solve various features suitable for BCI					[AP]
C529.4	Apply different translation models for a BCI system					[AP]
C529.5	Utilize BCI for various applications.					[AP]
Course Contents						
Unit – 1	INTRODUCTION TO BCI				CO1	9
Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal						
Unit – 2	ELECTROPHYSIOLOGICAL SOURCES				CO2	9
Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms.						
Unit – 3	FEATURE EXTRACTION METHODS				CO3	9
Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR,MA,ARMA models – PCA – Linear and Non-Linear Features.						
Unit – 4	FEATURE TRANSLATION METHODS				CO4	9
Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.						
Unit – 5	APPLICATIONS OF BCI				CO5	9
Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.						
					Total Hours	45
Textbooks:						
1	Nam, Chang S., Anton Nijholt, and Fabien Lotte, eds. Brain–computer interfaces handbook: technological and theoretical advances. CRC press, 2018.					
2	Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction”, Springer, 2011.					
Reference Books:						

1	R. Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 1981.
2	Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato,Florida, 1986.
3	Bishop C.M., “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 1995.

Web References:

1	Udemy course on Mastering Brain-Computer Interfaces & Neurotechnology
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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	20			
Apply	80	80	80			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C529.1	3	2	1	2									2
C529.2	3	2	1	2									2
C529.3	3	2	1	2									2
C529.4	3	2	1	2									2
C529.5	3	2	1	2									2

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

Prepared by

Approved by

Dr.N.K.Anushkannan HoD/ECE

Dr.N.K.Anushkannan HoD/ECE

Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
24EC530	Body Area Networks	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)					
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Course Objectives							
The student should be made to							
1	Study about basic concepts of Body Area Networks (BAN)						
2	Study about BAN requirement						
3	Learn about BAN in Wireless Communication						
4	Study the Security issues with BAN						
5	Study about BAN applications in the field of Medicine						
Course Outcomes							
Upon completion of the course, students will be able to							
C530.1	Understand about principles and architecture of BAN					[U]	
C530.2	Understand various hardware and power requirements for BAN					[U]	
C530.3	Explain wireless communications techniques used to build BAN					[U]	
C530.4	Identify Interferences and security issues with BAN					[AP]	
C530.5	Apply BAN in the field of sports medicine					[AP]	
Course Contents							
Unit – 1	INTRODUCTION					CO1	9
Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, EnergySupply, optimal node placement, number of nodes, System security and reliability, BANArchitecture – Introduction.							
Unit – 2	HARDWARE FOR BAN					CO2	9
Processor-Low Power MCUs, Mobile Computing MCUs, Integrated processor with radio transceiver, Memory Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna,Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.							
Unit – 3	WIRELESS COMMUNICATION AND NETWORK					CO3	9
RF communication in Body, Antenna design and testing, Propagation, Base Station-Networktopology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEEP802.15.13, IEEE 802.15.14, Zigbee.							
Unit – 4	COEXISTENCE ISSUES WITH BAN					C04	9
Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layerand data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security andSelf-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.							
Unit – 5	APPLICATIONS OF BAN					C05	9
Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, SportsMedicine, Electronic pill.							
Total Hours						45	
Textbooks:							
1	Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body						

	Area Networks Safety, Security, and Sustainability’’, Cambridge University Press, 2013					
2	Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012					
3	Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006.					
Reference Books:						
1	Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems’’, Springer, 2013.					
2	Guang-ZhongYang (Ed.), “Body Sensor Networks’’, Springer, 2006.					
3	Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.					
Web References:						
1	Tonex training courseon “WBAN”					
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	20			
Apply	80	80	80			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C530.1	3	2	1	2							1	1	2
C530.2	3	2	1	2							1	1	2
C530.3	3	2	1	2							1	1	2
C530.4	3	2	1	2							1	1	2
C530.5	3	2	1	2							1	1	2

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

Prepared by
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Approved by
Dr.N.K.Anushkannan HoD/ECE

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	THEORY	-	-			
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	Understand the text extraction techniques.					[U]
C601.2	Apply the clustering techniques for text mining.					[AP]
C601.3	Apply the classification techniques for text mining.					[AP]
C601.4	Apply visualization techniques and perform anomaly & trend detection.					[AP]
C601.5	Apply various Event operations in Text streams.					[AP]
Course Contents						
Unit – 1	TEXT EXTRACTION				CO1	9
Introduction- Rapid automatic keyword extraction: candidate keywords, keyword scores, adjoining keywords, extracted keywords-Benchmark evaluation: precision and recall, efficiency, stop list generation, Evaluation on new articles.						
Unit – 2	DOCUMENT CLUSTERING				CO2	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				CO3	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				CO4	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				CO5	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 ChengXiangZhai, 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 MehranSahami, “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.
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Assessment based on Continuous and End Semester Examination

BLOOM'S 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				100%	100%	100%
Understand	80%		20%			
Apply	20%	100%	80%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PSO 1	PSO 2	PSO 3
C601.1	3	3	3	3	-	-	-	-	-	-	-	3	3	2
C601.2	3	3	3	3	-	-	-	-	-	-	-	3	3	2
C601.3	3	3	3	3	-	-	-	-	-	-	-	3	3	2
C601.4	3	3	3	3	-	-	-	-	-	-	-	3	3	2
C601.5	3	3	3	3	-	-	-	-	-	-	-	3	3	2

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

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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						
C602.1	Understand the history and foundations of Artificial Intelligence.					[U]
C602.2	Understand the basic principles of AI in problem solving.					[U]
C602.3	Illustrate the different searching algorithms to find and optimize the solution for the given problem.					[AP]
C602.4	Illustrate the different gaming algorithms and identify the importance of knowledge representation in Artificial Intelligence.					[AP]
C602.5	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 J. Russell and Peter Norvig, “Artificial Intelligence A Modern Approach Fourth Edition Global Edition, Pearson Education- 2022.					
Reference Books:						
1	Saroj Kaushik, “Artificial Intelligence”, Cengage Learning India,2022					

2	Rich & Knight, Artificial Intelligence, Second edition, Tata McGraw-Hill 2009.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc24_cs08/preview
2	https://nptel.ac.in/domains/discipline/106?course=106_0

Assessment based on Continuous and End Semester Examination						
BLOOM'S 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				100%	100%	100%
Understand	80%	20%	60%			
Apply	20%	80%	40%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PSO 1	PSO 2	PSO 3
C602.1	3	1	1	1	-	-	-	-	-	-	-	3	-	1
C602.2	3	3	2	2	-	-	-	-	-	-	-	3	1	2
C602.3	3	3	2	2	-	-	-	-	-	-	-	3	1	2
C602.4	3	2	-	-	-	-	-	-	-	-	-	3	1	1
C602.5	3	2	-	-	-	-	-	-	-	-	-	1	1	2

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

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Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
24OE603	HEALTH INFORMATICS	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)					
MACHINE LEARNING		-					
Course Objectives							
1	To understand the health data formats, health care policy and standards.						
2	To apply the significance and need of data analysis and data visualization.						
3	To implement 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 various Machine Learning techniques for analysis.					[AP]	
C603.3	Apply various evaluation metrics on healthcare data.					[AP]	
C603.4	Analyze python frameworks on healthcare data.					[AN]	
C603.5	Analyze various healthcare management techniques.					[AN]	
Course Contents							
Unit – I	INTRODUCTION TO HEALTHCARE ANALYSIS					C01	9
Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy- Standardized code sets – Data Formats.							
Unit – II	ANALYTICS ON MACHINE LEARNING					C02	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					C03	9
Evaluation model: Sensitivity, Specificity, PPV, NPV, FPR, Accuracy, ROC, Precision Recall Curves, Valued target variables – Python: Variables and types, Data Structures and containers.							
Unit – IV	PYTHON IN HEALTHCARE					C04	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					C05	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	ChandanK.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	NilanjanDey, Amira Ashour , Simon James Fong, ChintanBhatl, “Health Care Data						

	Analysis and Management, First Edition, Academic Press, 2018.
3	Kulkarni ,Siarry, Singh ,Abraham, Zhang, Zomaya , Baki, "Big Data Analytics in HealthCare", Springer, 2020.
4	Deep Learning- Ian Goodfellow, YoshuaBenjio, Aaron Courville, The MIT Press.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc22_hs40/preview .

Assessment based on Continuous and End Semester Examination						
BLOOM'S 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				100%	100%	100%
Understand	40%		20%			
Apply	60%	50%	60%			
Analyze		50%	20%			
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PSO 1	PSO 2	PSO 3
C603.1	3	2	2	1	1	-	-	-	-	-	-	3	3	3
C603.2	3	3	2	2	2	-	-	-	-	-	-	3	3	3
C603.3	3	3	2	2	2	-	-	-	-	-	-	3	3	3
C603.4	3	2	2	1	1	-	-	-	-	-	-	3	3	3
C603.5	3	2	3	1	1	-	-	-	-	-	-	3	3	3

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

Prepared by

Approved by

Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
24OE604	MANAGEMENT ANALYTICS	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 explain the relationship between Business Analytics and organizational decision-making.						
2	To analyze organizational structures for effective Business Analytics.						
3	To apply the appropriate analytics and generate solutions.						
4	To model and analyse the business situation using analytics.						
5	To recognize the concepts and techniques of prescriptive analytics						
Course Outcomes							
Upon completion of the course, students will be able to							
C604.1	Understand the fundamental concepts, terminologies, processes, and importance of Business Analytics in decision making.					[U]	
C604.2	Demonstrate the management of BA personnel, data, and technology.					[AP]	
C604.3	Apply descriptive analytics techniques to visualize, explore, and summarize the data.					[AP]	
C604.4	Apply the principles of predictive analytics, including logic-driven and data-driven models.					[AP]	
C604.5	Analyze the application of prescriptive analytics in demonstrating business performance improvement.					[AN]	
Course Contents							
Unit – 1	INTRODUCTION TO BUSINESS ANALYTICS (BA)					C01	9
Business Analytics –Terminologies-Process-Importance-Relationship with Organisational Decision Making-Analytics in Decision Making-BA for Competitive Advantage.							
Unit – 2	MANAGEING RESOURCES FOR BUSINESS ANALYTICS					C02	9
Managing BA Personnel-Data and Technology - Organisational Structures aligning BA-Managing Information policy-data quality and change in BA.							
Unit – 3	DESCRIPTIVE ANALYTICS					C03	9
Introduction to Descriptive analytics – Visualising and Exploring Data – Descriptive Statistics - Sampling and Estimation - Probability Distribution for Descriptive Analytics -Analysis of Descriptive analytics.							
Unit – 4	PREDICTIVE ANALYTICS					C04	9
Introduction to Predictive analytics - Logic and Data Driven Models - Predictive Analysis -Modeling and procedure - Data Mining for Predictive analytics. Analysis of Predictive analytics.							
Unit – 5	PRESCRIPTIVE ANALYTICS					C05	9
Introduction to Prescriptive analytics - Prescriptive Modeling - Non Linear Optimization - Demonstrating Business Performance Improvement.							
Total Hours						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 and Decision Making", Fifth edition, Cengage Learning, 2015.
Reference Books:	
1	James R. Evans, "Business Analytics - Methods, Models and Decisions", Pearson Ed, 2012.
Web References:	
1	https://www.coursera.org/learn/introduction-to-business-analytics
2	https://onlinecourses.swayam2.ac.in/imb20_mg19/preview
3	https://cce.iisc.ac.in/cce-proficiency/prescriptive-analytics-jm-2025/

Assessment based on Continuous and End Semester Examination						
BLOOM'S 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				100%	100%	100%
Understand	80%		20%			
Apply	20%	100%	60%			
Analyze			20%			
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
C604.1	2	1	-	-	-	-	-	-	-	-	1			
C604.2	2	2	2	2	-	-	-	-	-	-	3			
C604.3	3	3	2	2	-	-	-	-	-	-	-			
C604.4	3	3	3	3	-	-	-	-	-	-	-			
C604.5	3	3	3	2	-	-	-	-	-	-	2			

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

Prepared by

Approved by

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24OE605	DATA SCIENCE ESSENTIALS	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)				
CourseObjectives						
1	To understandthe 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 of the 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 potential bottlenecks and areas for optimization.					[AP]
C605.3	Apply machine learning algorithms to solve classification and regression problems, using appropriate tools and techniques.					[AP]
C605.4	Apply various data visualization techniques using Matplotlib and Seaborn to create and customize visual representations of complex datasets					[AP]
C605.5	Apply techniques and programming strategies to handle large volumes of data effectively by leveraging appropriate tools and methods					[AP]
CourseContents						
Unit – I	INTRODUCTION					6
Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data.						
Unit – II	DATA MANIPULATION					12
Python Shell - Jupyter Notebook - IPython Magic Commands - NumPy Arrays-Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance						
Unit – III	MACHINE LEARNING					9
The modeling process - Types of machine learning - Supervised learning - Unsupervised learning - Semi-supervised learning- Classification, regression - Clustering – Outliers and Outlier Analysis.						
Unit – IV	DATA VISUALIZATION					9
Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three-dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.						
Unit – V	HANDLING LARGE DATA					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 and automation.						
Total Hours						45
Textbooks:						
1	David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.					

2	VanderPlas, Jake. Python Data Science Handbook: Essential Tools for Working with Data. O'Reilly Media, 2nd ed., 2022. ISBN 978- 1098121228.
ReferenceBooks:	
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.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc24_cs68/preview
2	https://archive.nptel.ac.in/courses/106/106/106106139/

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	50%		20%			
Apply	50%	100%	80%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02	PS03
C605.1	3	3	2	2	3	1	-	-	1	2	1			
C605.2	3	3	3	2	3	-	-	-	1	2	2			
C605.3	3	3	3	3	3	-	-	-	1	2	2			
C605.4	2	2	3	2	3	-	-	-	1	3	2			
C605.5	3	3	3	3	3	1	-	-	2	2	3			

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Course Code	Course Name	Category	Hours/Week			C	
			L	T	P		
240E606	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	9 Hrs
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	9 Hrs
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	9 Hrs
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	9 Hrs
Shape from X - Active range finding - Surface representations - Point-based representations - Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.							
Unit – 5	IMAGE-BASED RENDERING AND RECOGNITION					C05	9 Hrs
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	https://archive.nptel.ac.in/courses/106/105/106105216/
2	https://opencv.org/opencv-free-course/

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						
Total (100 Marks)	6	6	8	10	10	60

- 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	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

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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, 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
Text books:						
1	EthemAlpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020.					

2	Stephen Marsland, “Machine Learning: An Algorithmic Perspective, “Second Edition”, CRC Press, 2022.
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Reference Books:

1	Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
2	Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition, 1997.
3	MehryarMohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, Second Edition, MIT Press, 2018.
4	Ian Goodfellow, YoshuaBengio, Aaron Courville, “Deep Learning”, MIT Press, 2016
5	SebastainRaschka, Vahid Mirjalili , “Python Machine Learning”, Packt publishing 3rd Edition, 2019.

Web References:

1	https://www.coursera.org/lecture/python-machine-learning/introduction-4f2So2
2	https://nptel.ac.in/courses/106/106/106106139/

Assessment based on Continuous and End Semester Examination

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

- 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	P O1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 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

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
240E608	Deep Learning Techniques	OE	3	0	0	3
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
2024	Theory	V	-			
Pre-requisite Course(s)		Co-requisite Course(s)				
Fundamentals of Machine Learning		Artificial Intelligence				
Course Objectives						
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.					
Course Outcomes						
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
Course Contents						
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.
Reference Books:	
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.
Web References:	
1	https://nptel.ac.in/courses/
2	https://aikosh.indiaai.gov.in/static/Deep+Learning+Ian+Goodfellow.pdf

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						
Total (100 Marks)	6	6	8	10	10	60

- 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

Prepared by

Approved by

Course Code	Course Name	Category	Hours/ Week	C		
			L	T	P	
24OE609	Language engineering	OE	3	0	2	4
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R24	Theory	4	-----			
Pre-requisite Course(s)		Co-requisite Course(s)				
Nil		Natural Language processing				
Course Objectives						
1	To understand the fundamentals of natural language processing					
2	To construct the word level analysis methods					
3	To identify word class methods and models					
4	To construct Context Free Grammar in syntactic analysis					
5	To develop parsing concepts in syntactic analysis					
Course Outcomes						
Upon completion of the course, students shall have ability to						
C609.1	Understand basic language features for the given text.					U
C609.2	Build a rule based system to tackle morphology/syntax of a language					AP
C609.3	Build a rule based tagging and models for word level applications.					AP
C609.4	Apply different statistical approaches for CFG applications.					AP
C609.5	Build innovative parsing concepts to process natural language.					AP
Course Contents						
Unit – 1	INTRODUCTION					9
Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.						
Unit – 2	WORD LEVEL ANALYSIS					9
Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging.						
Unit – 3	WORD LEVEL MODELS					9
Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.						
Unit – 4	SYNTACTIC ANALYSIS -Context-Free Grammars					9

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar.		
Unit – 5	SYNTACTIC ANALYSIS -Parsing concepts	9
Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures.		
Total Hours		45
Textbooks:		
1	Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.	
2	Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, O'Reilly Media, 2009.	
Reference Books:		
1	Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.	
2	Richard M Reese, —Natural Language Processing with Javal, O'Reilly Media, 2015.	
4	Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.	
Web References:		
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 (6 Marks)	CIA2 (6 Marks)	Model Exam (8 Marks)			
Remember				(10 Marks)	(10 Marks)	(60 Marks)
Understand	80%	20%	20%			
Apply	20%	80%	80%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1 0	PO1 1	PO1 2	PSO 1	PSO 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	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 back propagation algorithms 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					CO1 9 Hrs
Neuron, nerve structure and synapse. Artificial neuron and its model. Activation functions. Neural network architecture: single layer feed forward networks, multilayer feed forward networks, recurrent networks. Various learning techniques: perceptron learning rule, convergence rule. Auto-associative memory and hetero-associative memory.						
Unit – 2	Back Propagation Networks					CO2 10 Hrs
Architecture of neural networks. Perceptron model and solution. Single layer artificial neural network. Multilayer perceptron model. Back propagation learning methods. Effect of learning rule coefficient. Back propagation algorithm. Factors affecting back propagation training. Applications of back propagation networks.						
Unit – 3	Fuzzy Logic – I (Introduction)					CO3 8 Hrs
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)					CO4 9 Hrs
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)					CO5 9 Hrs
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.
Web References:	
1	NPTEL Course – Fuzzy Logic and Neural Networks https://nptel.ac.in
2	Stanford Online – Machine Learning Resources https://online.stanford.edu

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						
Total (100 Marks)	6	6	8	10	10	60

- 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	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

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SYLLABI OPENELECTIVES
(APPLICABLE FOR STUDENTS ADMITTED FROM 2024-2025)

Course Code	CourseName	Category	Hours/Week			C
			L	T	P	
24OE611	DATABASEFUNDAMENTALS	OE	3	0	0	3
Regulation	NatureoftheCourse	Semester	DataBook/Codes/Standards			
2024	THEORY	-	-----			
Pre-requisiteCourse(s)		Co-requisiteCourse(s)				
-		-				
CourseObjectives						
1	Tolearnthefundamentalsodatamodels,relationalalgebraandSQL					
2	TorepresentadatabasesystemusingERdiagramsandtolearnnormalizationtechniques					
3	TohaveanintroductoryknowledgeabouttheDistributeddatabases,NOSQLanddatabase security					
CourseOutcomes						
Uponcompletionofthecourse,studentsshallhaveabilityto						
OE611.1	TounderstandbasicsofDatabases					[U]
OE611.2	TounderstandbasicsofRelationalDatabases					[U]
OE611.3	TodesigndatabaseusingERmodelandnormalizethedatabase					[AP]
OE611.4	ToapplydatabaseconceptsondistributedDatabases					[AP]
OE611.5	ToapplydatabaseconceptsonDatabaseSecurity					[AP]
CourseContents						
Unit-1	Introduction				CO1	8
IntroductiontoDatabases-DatabaseModels-ComponentsofaDBMS-TypesofDatabases-PurposeofDatabase System-Viewsofdata-DataModels-DatabaseSystemArchitecture-ApplicationsofDatabases						
Unit-2	RelationalDatabases				CO2	10
Introductiontorelationaldatabases-RelationalModel-Keys-RelationalAlgebra-SQLfundamentals- Advanced SQL features - Embedded SQL- Dynamic SQL						
Unit-3	DatabaseDesign				CO3	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 NormalForm						
Unit-4	DistributedDatabases				CO4	9
Architecture,DataStorage,TransactionProcessing,Queryprocessingandoptimization-NOSQLDatabases: Introduction-CAPTheorem-DocumentBasedsystems -KeyvalueStores-ColumnBasedSystems-Graph Databases						
Unit-5	DatabaseSecurity				CO5	9
Securityissues-Accesscontrolbasedonprivileges -RoleBasedaccesscontrol-SQLInjection-Statistical Databasesecurity-Flowcontrol-EncryptionandPublicKeyinfrastructures-Challenges						
					TotalHours	45
Textbooks:						
1	AbrahamSilberschatz, HenryF.Korth, S.Sudharshan, "DatabaseSystemConcepts", Seventh Edition, McGrawHill, 2020.					
2	RamezElmasri, ShamkantB.Navathe, "FundamentalsofDatabaseSystems", SeventhEdition, Pearson Education, 2017					
ReferenceBooks:						
1	C.J.Date, A.Kannan, S.Swamynathan, "AnIntroductiontoDatabaseSystems", EighthEdition, Pearson Education. 2006.					

2	ThomasConnolly,CarolynBegg,“DatabaseSystems:APracticalApproachtoDesign, Implementation and Management”, Sixth Edition, Pearson Education, 2015.
3	HectorGarcia-Molina,JeffreyD.Ullman,JenniferWidom,“DatabaseSystems:TheCompleteBook”, Second Edition, Pearson Education, 2009.
WebReferences:	
1.	https://nptel.ac.in/courses/106104135
2.	https://onlinecourses.nptel.ac.in/noc22_cs91/preview

AssessmentbasedonContinuousandEndSemesterExamination						
Bloom's Level	ContinuousAssessment			Assignment (10Marks)	Attendance (10Marks)	EndSemester Examination (60Marks)
	CIA1 (6Marks)	CIA2 (6Marks)	ModelExam (8Marks)			
Remember				10	10	60
Understand	100	60	80			
Apply		40	20			
Analyze						
Evaluate						
Create				10	10	60
Total(100 Marks)	6	6	8			

- CIA1,CIA2andModelExamwillbeconductedfor50,50and100marks.Itshallbesubsequentlyconvertedto 6, 6 and 8 marks respectively.
- TheAssignmentmarkswillbecomputedbasedonAssignmentI,AssignmentIIandAssignmentIIImarks converted to 10 Marks.
- BTLmarksplutopmayvarybasedonthenatureofthesubject.

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	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

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Course Code	CourseName	Category	Hours/Week			C
			L	T	P	
24OE612	BASICSOFIGIMAGEPROCESSING	OE	3	0	0	3
Regulation	NatureoftheCourse	Semester	DataBook/Codes/Standards			
2024	THEORY	-	-----			
Pre-requisiteCourse(s)		Co-requisiteCourse(s)				
-		-				
CourseObjectives						
1	Tobecomefamiliarwithdigitalimagefundamentals.					
2	TogetexposedtosimpleimageenhancementtechniquesinSpatialandFrequencydomain.					
3	Tolearnconceptsofdegradationfunctionandrestorationtechniques.					
4	Tostudytheimagesegmentationandrepresentationtechniques.					
5	Tobecomefamiliarwithimagecompressionandrecognitionmethods					
CourseOutcomes						
Uponcompletionofthecourse,studentsshallhaveabilityto						
OE612.1	Tounderstandthebasicsandfundamentalsofdigitalimageprocessing,suchas digitization,sampling,quantization,and2D-transforms					[U]
OE612.2	Tounderstandonimagesusingthetechniquesofsmoothing,sharpeningand enhancement					[U]
OE612.3	Toapplytherestorationconceptsandfilteringtechniques.					[AP]
OE612.4	Tolearnthebasicssegmentationmethods					[AP]
OE612.5	ToComprehendcompressionandrecognitionconcepts.					[AP]
CourseContents						
Unit-1	DIGITALIMAGEFUNDAMENTALS				CO1	10
StepsinDigitalImageProcessing–Components–ElementsofVisualPerception–ImageSensingand Acquisition–ImageSamplingandQuantization–Relationshipsbetweenpixels-Colorimagefundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.						
Unit-2	IMAGEENHANCEMENT				CO2	8
Grayleveltransformations–Histogramprocessing–BasicsofSpatialFiltering,FrequencyDomain:Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters						
Unit-3	IMAGERESTORATION				CO3	9
ImageRestoration-degradationmodel,Properties,Noisemodels–MeanFilters–OrderStatistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters						
Unit-4	IMAGESEGMENTATION				CO4	9
Edgedetection,EdgelinkingviaHoughtransform –Thresholding-Regionbasedsegmentation–Regiongrowing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphologicalwatersheds–basicconcepts.						
Unit-5	IMAGECOMPRESSIONANDRECOGNITION				CO5	9
Needfordatacompression,Huffman,RunLengthEncoding,Shiftcodes,Arithmeticcoding,JPEGstandard,MPEG. Boundary representation, Boundary description, FourierDescriptor, Regional Descriptors – Topological feature, Texture-PatternsandPatternclasses-Recognitionbasedonmatching.						
					TotalHours	45
Textbooks:						
1	AbrahamSilberschatz, HenryF.Korth, S.Sudharshan, “DatabaseSystemConcepts”, Seventh Edition, McGrawHill, 2020.					
2	RamezElmasri, ShamkantB.Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education, 2017					
ReferenceBooks:						
1	C.J.Date, A.Kannan, S.Swamynathan, “AnIntroductiontoDatabaseSystems”, Eighth Edition, Pearson Education, 2006.					
2	RafaelC.Gonzalez, RichardE.Woods, “Digital ImageProcessing”, Fourth Edition, Pearson Education, 2018.					

3	AnilK.Jain,“Fundamentals of Digital Image Processing”,First Edition,Prentice Hall,1989.
WebReferences:	
1.	https://onlinecourses.nptel.ac.in/noc22_ee116/preview
2.	https://onlinecourses.nptel.ac.in/noc26_ee31/preview

Assessment based on Continuous and End Semester Examination						
Bloom's Level	Continuous Assessment			Assignment (10Marks)	Attendance (10Marks)	End Semester Examination (60Marks)
	CIA1 (6Marks)	CIA2 (6Marks)	Model Exam (8Marks)			
Remember				10	10	60
Understand	100	60	80			
Apply		40	20			
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 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	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

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Course Code	CourseName	Category	Hours/Week			C	
			L	T	P		
24OE613	VEHICULARADHOCNETWORKS	OE	3	0	0	3	
Regulation	NatureoftheCourse	Semester	DataBook/Codes/Standards				
2024	THEORY	-	-----				
Pre-requisiteCourse(s)		Co-requisiteCourse(s)					
-		-					
CourseObjectives							
1	ToteachthestudentsconceptsofVANET.						
2	TounderstandaboutMessageforwardingandChallengesofvehicularsystems						
3	Tounderstandimplementationscope,applicationsandcasestudiesofVANET.						
CourseOutcomes							
Uponcompletionofthecourse,studentsshallhaveabilityto							
OE613.1	TounderstandVANETBasics					[U]	
OE613.2	Tocomprehendthemessageforwardingstrategies.					[U]	
OE613.3	TounderstandthechallengesinVANET					[U]	
OE613.4	ToapplyVANETindifferentservicesandtounderstandthroughsimulation					[AP]	
OE613.5	ToapplyVANETconceptsindifferentapplications					[AP]	
CourseContents							
Unit-1	INTRODUCTIONTOVANET					CO1	9
VANET Basics – Scenarios – Components of VANET -Need and Characteristics of VANET – Communication in VANET:Types,IntroductiontoDSRC:IEEE1609.0,1609.1,1609.2,1609.3,1609.4,IEEE802.11P –Physicaland MAClayer.							
Unit-2	MESSAGINGFORWARDINGSTRATEGIES					CO2	9
TypesofmessagesinVANET,MessageForwardingStrategies,MessagePacketFormat,NeedofPriority-Based Message Forwarding, Priority assigning mechanism,							
Unit-3	CHALLENGESINVANET					CO3	9
Challenges:Volatility,CriticalTimelatency,Diversenetworkingstandards,HighMobilityofnodes,Network Security, Efficient Message forwarding, Mitigation Techniques to address VANET Security							
Unit-4	SCOPEANDAPPLICATIONOFVANET					CO4	9
Scope of VANET, Application of VANET, Traffic Management, User-Oriented Services, Convenience Services, PotentialProjects,ToolsandSimulationPlatformofVANET, Conclusions–VANETandIntelligentTransportation System							
Unit-5	CASESTUDIES					CO5	9
Learning-BasedRogueEdgeDetectioninVANETswithAmbientRadioSignals, LearningWhileOffloading:Task Offloading in Vehicular Edge Computing Network, Intelligent Network Access System for Vehicular Real-Time ServiceProvisioning,UAVRelayinVANETsAgainstSmartJammingwithReinforcementLearning							
TotalHours						45	
Textbooks:							
1	Botkar,SonaliP.,etal.VANET:challengesandopportunities.CRCPress,2021.						
2	Xiao,Liang,etal.Learning-basedVANETcommunicationandsecuritytechniques.Springer InternationalPublishing,2019.						
3	Hartenstein,Hannes,andKennethLaberteaux,eds.VANET:vehicularapplicationsandinter-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."TheJournalofNavigation51.3(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 (10Marks)	Attendance (10Marks)	End Semester Examination (60Marks)
	CIA1 (6Marks)	CIA2 (6Marks)	Model Exam (8Marks)			
Remember				10	10	60
Understand	100	100	60			
Apply			40			
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 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	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

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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							
Upon completion of the course, students shall have ability to							
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 application 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	FUNDAMENTALS OF WEB TECHNOLOGIES					CO1	9
Web Essentials: Understanding Clients, Servers, and Communication - Internet Fundamentals: World Wide Web- HTTP Request and Response Messages -HTML5: Introduction to HTML5 Tags, Tables, Lists, and Images -HTML5 Control Elements: Forms, Input Types, Drag and Drop, Audio, and Video - CSS3: Inline, Embedded, and External Stylesheets- Rule Cascading and Inheritance in CSS3- CSS3 Transitions, Animations & Transformations- Bootstrap Framework: Using the Bootstrap Grid System, Responsive Design Principles, and Components							
Unit-2	CLIENT-SIDE PROGRAMMING					CO2	9
JavaScript : Variables, Functions, Loops, Conditional Statements - DOM Manipulation: Selecting Elements, Modifying Content and Attributes- Exception Handling: Try-Catch Blocks, Throwing Custom Errors - Form Validation: Using JavaScript to Validate User Input -DHTML with JavaScript: Creating Dynamic Web Pages- JSON: Parsing JSON.							
Unit-3	SERVER-SIDE PROGRAMMING					CO3	9
Java Servlet Technology: Servlet Architecture and Lifecycle- Handling HTTP Requests and Sessions: Form GET/POST, Cookies, URL Rewriting- JDBC: Connecting to Databases, Performing CRUD Operations- Advanced Java Concepts: Introduction to JSP Architecture- Database Connectivity: MySQL, SQLite.							
Unit-4	PHP AND XML					CO4	9
PHP Basics: Syntax, Variables, Operators, Data Types, Conditionals, Arrays, Functions, Form Handling, and Validation- XML Basics: Understanding XML Structure, DTD, and XML Schemas -XML Parsing: Using DOM and SAX Parsers in PHP.							
Unit-5	MODERN WEB APPLICATION FRAMEWORKS					CO5	9
Introduction to AngularJS and Angular 2+: MVC Architecture, Components, Directives - Angular Data Binding: Expressions, ngModel, ng-repeat- React Basics: Component-Based Architecture, JSX, Props, State- Node.js Basics: Event-driven, Non-blocking I/O, Server-Side JavaScript- Express Framework: Building RESTful APIs with Express and Node.js- Django Framework: MVC/MVT Architecture, Python in Web Apps.							
Total Hours						45	
Textbooks:							
1	Harvey, Harvey Deitel, and Abbey Deitel. "Internet and World Wide Web How To Program." (2011).						
2	Jeffrey, C. "Jackson, "Web Technologies A Computer Science Perspective". "(2011).						
3	Uluca, Doguhan. Angular 6 for Enterprise- Ready Web Applications: Deliver production-ready and cloud-scale Angular web apps. Packt Publishing Ltd, 2018.						
Reference Books:							

1	StephenWynkoopandJohnBurke“RunningaPerfectWebsite”,QUE,2ndEdition,1999
2	ChrisBates,WebProgramming–BuildingIntranetApplications,3rdEdition,WileyPublications, 2009.
3	GopalanN.P.andAkilandeswariJ.,“WebTechnology”,PrenticeHallofIndia,2011
WebReferences:	
1.	https://onlinecourses.swayam2.ac.in/e-learning/preview/nou24_cs09
2.	https://onlinecourses.swayam2.ac.in/e-learning/preview/nou23_cs03

AssessmentbasedonContinuousandEndSemesterExamination						
Bloom's Level	ContinuousAssessment			Assignment (10Marks)	Attendance (10Marks)	EndSemester Examination (60Marks)
	CIA1 (6Marks)	CIA2 (6Marks)	ModelExam (8Marks)			
Remember				10	10	60
Understand	80	100	20			
Apply	20		80			
Analyze						
Evaluate						
Create						
Total(100 Marks)	6	6	8	10	10	60

- CIA1,CIA2andModelExamwillbeconductedfor50,50and100marks.Itshallbesubsequentlyconvertedto 6, 6 and 8 marks respectively.
- TheAssignmentmarkswillbecomputedbasedonAssignmentI,AssignmentIIandAssignmentIIImarks converted to 10 Marks.
- BTLmarksplitupmayvarybasedonthenatureofthesubject.

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	PSO 3
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

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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	TolearndevelopmentofnativeapplicationswithbasicGUIComponents						
2	Todevelopcross-platformapplicationswitheventhandling						
3	Todevelopapplicationswithlocationanddatastoragecapabilities						
4	Todevelopwebapplicationswithdatabaseaccess						
CourseOutcomes							
Uponcompletionofthecourse,studentsshallhaveabilityto							
OE615.1	Tounderstandvariousmobileappdevelopmentmodel.					[U]	
OE615.2	Todesignsimplenativeandcross-platformmobileapplications					[AP]	
OE615.3	ToapplyframeworkssuchasReactNativeandIonicEffectively					[AP]	
OE615.4	Toevaluateframeworksbasedonperformanceanddevelopmentneeds					[AP]	
OE615.5	Tounderstandappdeployment,debugging,andmaintenancefundamentals					[AP]	
CourseContents							
Unit-1	FUNDAMENTALSOFWEBANDMOBILEAPPLICATIONDEVELOPMENT					CO1	9
Introduction to mobile and web app ecosystems -Native apps – architecture and characteristics - Hybrid apps – architectureandusecases-Cross-platformapps–conceptandusecases-ProgressiveWebApps(PWA)– functionalityandofflinecapabilities-ResponsiveWebDesign–fluidlayouts,mediaqueries,flexiblegrids.							
Unit-2	NATIVEAPPDEVELOPMENT					CO2	9
NativeAndroiddevelopment–JavaandKotlinbasics-NativeiOSdevelopment–SwiftandObjective-Coverview-Android Studio and Xcode – IDE walkthrough - Activity lifecycle, Views, and UI components - Permissions, local storage, and app manifest configuration -Introduction to Gradle build process - Play Store and App Store – submission basics and guidelines.							
Unit-3	HYBRIDAPPDEVELOPMENT					CO3	9
Hybridappstructure–HTML,CSS,JavaScript with WebView -ApacheCordova –pluginsandnativeaccess -Ionic framework – UI toolkit and component structure - Integration with device features – camera, GPS, storage - Debugging and testing hybrid apps on emulators and devices - Performance considerations and offline support-Enterpriseapplications–hybridusecases.							
Unit-4	CROSS-PLATFORMAPPDEVELOPMENT					CO4	9
Cross-platformframeworks–needandcomparison-ReactNative–components,JSX,props,state-Flutter–Dart basics,widgets,statemanagement-Navigationandroutinginmobileapps-Hotreloadanddebuggingtechniques -Platform-specificcodeincross-platformapps-IntegrationwithRESTAPIsandFirebase–Overview.							
Unit-5	NON-FUNCTIONALASPECTSANDDEPLOYMENTSTRATEGIES					CO5	9
Frameworkcomparison–performance,flexibility,andscalability-Appperformance–rendering,responsiveness, startuptime-Debuggingandprofilingtools–AndroidDebugBridge,FlutterDevTools,ReactDevTools -Time-to-market and maintainability - UI/UX consistency – Material Design, Human Interface Guidelines - CI/CD pipelines – GitHub Actions, Fastlane - Version control, build automation, and testing workflows - Basics of analytics, crash reporting,anduserfeedback.							
TotalHours						45	
Textbooks:							
1	Griffiths,Dawn,andDavidGriffiths.Headfirstandroiddevelopment:abrain-friendlyguide." O'Reilly Media, Inc.", 2017.						
2	Camden,RaymondK.ApacheCordovainaction.SimonandSchuster,2015.						
3	Abbott,Devin,etal."FullstackReactNative."(2017).						
ReferenceBooks:							
1	Horton,John.Androidprogrammingforbeginners.PacktPublishingLtd,2015.						
2	Lewis,Shaun,andMikeDunn.Nativemobiledevelopment:across-referenceforiOSandAndroid.						

	O'ReillyMedia,2019.
3	Lingras,Rucha,MattTriff,andRuchaLingras.BuildingCross-PlatformMobileandWebAppsfor Engineers and Scientists. Cengage Learning, Incorporated, 2016.
4	Wargo,JohnM.ApacheCordova4Programming.PearsonEducation,2015.
5	Ward,Dan.ReactNativeCookbook:RecipesforsolvingcommonReactNative development problems. Packt Publishing Ltd, 2019.
WebReferences:	
1.	https://onlinecourses.swayam2.ac.in/e-learning/preview/nou22_ge25
2.	https://onlinecourses.nptel.ac.in/noc20_cs52/preview

AssessmentbasedonContinuousandEndSemesterExamination						
Bloom's Level	ContinuousAssessment			Assignment (10Marks)	Attendance (10Marks)	EndSemester Examination (60Marks)
	CIA1 (6Marks)	CIA2 (6Marks)	ModelExam (8Marks)			
Remember				10	10	60
Understand	80	100	20			
Apply	20		80			
Analyze						
Evaluate						
Create						
Total(100 Marks)	6	6	8	10	10	60

- CIA1,CIA2andModelExamwillbeconductedfor50,50and100marks.Itshallbesubsequently 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.
- BTLmarksplitupmayvarybasedonthenatureofthesubject.

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	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

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24OE616	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 internals 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 I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits 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 ToolKit – Java 3D – Comparison of World ToolKit 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 .

Total Hours | **45**

Text books:

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.

Reference Books:

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

Web References:

1	https://en.wikipedia.org/wiki/Augmented_reality
2	https://developers.google.com/ar
3	https://unity.com/unity/features/arfoundation

Assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			Assign ment	Attend ance	End Semester Exa mination
	CIA1 (6 Marks)	CIA2 (6 Marks)	Model Exam (8 Marks)			
Remember				(10 Marks)	(10 Marks)	(60 Marks)
Understand	100	20%	40%			
Apply		80%	60%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1 0	PO1 1	PO1 2	PSO 1	PSO 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

Prepared by

Approved by

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24OE617	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 – Petrinets – 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 Agile Unified Methodology, First Edition, Mc Graw-Hill International Edition, 2014.
Reference Books:	
1	Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2nd edition, PHI Learning Pvt. Ltd., 2010.
2	Len Bass, Ingo Weber and Liming Zhu, “DevOps: A Software Architect’s Perspective”, Pearson Education, 2016
3	Stephen Schach, Object-Oriented and Classical Software Engineering, 8th ed, McGraw-Hill, 2010.
Web References:	
1	Onlinecourses.nptel.ac.in

Assessment based on Continuous and End Semester Examination						
Bloom’sLevel	ContinuousAssessment			Assignmen t	Atten danc e	End SemesterExaminati on
	CIA1 (6Marks)	CIA2 (6Marks)	Model Exam (8Marks)			
Remember				(10 Marks)	(10 Mark s)	(60Marks)
Understand	100%	20%	40%			
Apply		80%	60%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO11	PO12	PSO1	PSO2
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 - Strong 2 - Moderate 1 - Weak - - no correlation

Prepared by

Approved by

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24OE618	Foundation of cloud computing	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 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.(check edition)
Reference Books:	
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.
Web References:	
1	https://medium.com/beyond-the-build/foundations-of-cloud-computing-saas-paas-iaas-for-product-managers-and-non-tech-professionals-63acf8c1a2bc
2	https://onlinelibrary.wiley.com/

Assessment based on Continuous and End Semester Examination						
Bloom’sLevel	ContinuousAssessment			Assign ment	Attend ance	End SemesterExa mination
	CIA1 (6Marks)	CIA2 (6Marks)	Model Exam (8Marks)			
Remember				(10 Marks)	(10 Marks)	(60Marks)
Understand	80%	20%	20%			
Apply	20%	80%	80%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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	
240E619	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.					
Reference Books:						

1.	E Balagurusamy, 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.
Web References:	
1.	https://onlinecourses.nptel.ac.in/noc25_cs57/preview

Assessment based on Continuous and End Semester Examination

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

- 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	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

Prepared by

Approved by

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
240E620	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 crypto currency, 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, Attacks 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	Daniel Drescher, "Blockchain Basics", First Edition, Apress, 2017.
3	Blockchain Basics: A Non-Technical Introduction in 25 Steps, Author- Daniel Drescher, Apress, First Edition, 2017
4	Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014
5	Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.
Web References:	
1	https://blockchain-society.science/
2	https://www.coursera.org/learn/blockchain-basics

Assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			Assignm ent	Attenda nce	End Semester Examination
	CIA1 (6 Marks)	CIA2 (6 Marks)	Model Exam (8 Marks)			
Remember				(10 Marks)	(10 Marks)	(60 Marks)
Understand	100%	80%	80%			
Apply		20%	20%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1 0	PO1 1	PO1 2	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

Prepared by

Approved by

OPEN ELECTIVES OFFERED BY EEE

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24OE626	Industrial Automation With PLC and SCADA	OE	3	0	0	3
Course Outcomes (s)						
Upon completion of the course, students shall have ability to						RBT
C626.1	Understand the integrated industrial automation system.					U
C626.2	Identify the PLC hardware and programming languages for various applications.					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
Course Content						
Unit-I	INTRODUCTION					9
Architecture of the basic three level Integrated Industrial Automation Systems – Field level for sensors actuators and smart devices, Control level for process and motion control functions, Distributed control system - Supervisory level for Data logging and Acquisition systems – DAS and SCADA for Management functions - Integrated automation through bus structure at the different levels.						
Unit - II	INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLER					9
Overview of Programmable Logic Controller – Architecture – Principle of operation – I/O Modules: Discrete, Analog, Special – I/O Specifications – CPU – Memory design and types – Programming devices – Recording and Retrieving data – PLC programming languages. Introduction to Human Machine Interfaces (HMI).						
Unit-III	BASIC PLC PROGRAMMING					9
Fundamentals of Logic – Program Scan – Relay-Type Instructions – Instruction addressing – Branch and Internal relay instructions – Entering the Ladder diagram – Electromagnetic Control relays – Contactors – Motor Starters – Manual operated switches and Mechanically operated switches.						
Unit-IV	SCADA					9
Introduction to SCADA – A brief history of SCADA – Real-time systems – Remote control – Communications: communication system components – protocol-modems – Remote terminal units (RTUs) – Master terminal units (MTUs).						
Unit-V	APPLICATIONS OF SCADA					9
Applications: Real time Revisited – Accounting and grade of data – Scanning and communications – Automatic control. Applications SCADA for Power Utility Network.						
Total Hours						45
Learning Resources						
Text books						
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 , New Delhi, 2019.					
3	Stuart A. Boyer, “SCADA: Supervisory Control and Data Acquisition”, 4th Edition, ISA Press, USA, 2009.					
Reference Books						
1	Webb John W & Reis Ronald A, "Programmable Logic Controllers - Principles and Applications", 5th Edition, PHI Learning Private Limited, New Delhi, 2002.					
2	Bolton W, “Programmable Logic Controllers”, 5th Edition, Elsevie , New York, 2009.					
Web References						
1	https://www.nielit.gov.in/calicut/content/online-course-industrial-automation-plc-scada					
2	https://www.nielit.gov.in/calicut/content/iad102					

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
240E627	Electric Vehicle Technology	OE	3	0	0	3
Course Outcomes (s)						
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

Course Content		
Unit-I	INTRODUCTION TO ELECTRIC VEHICLES	9
Sustainable Transportation – EV System – EV Advantages – Vehicle Mechanics – Performance of EVs – Electric Vehicle drive train – EV Transmission Configurations and components -Tractive Effort in Normal Driving – Energy Consumption – EV Market – Types of Electric Vehicle in Use Today – Electric Vehicles for the Future		
Unit – II	ELECTRIC VEHICLE DESIGN CONSIDERATIONS	9
General Description of Vehicle Movement - Vehicle Resistance – Dynamic Equation - Power Train Tractive Effort and Vehicle Speed - Vehicle Power Plant and Transmission Characteristics - Vehicle Performance - Brake Performance - EV configurations – General and Typical EV configurations - EV parameters		
Unit-III	HYBRID TRACTION	9
Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies-power flow controls in hybrid drive-train topologies - Basic concept of electric traction- Introduction to various electric drive-train topologies- fuel efficiency analysis.		
Unit-IV	HYBRID VEHICLE CONTROL STRATEGY	9
Vehicle Supervisory Controller- Mode Selection Strategy -Mechanical Power-Split Hybrid Modes - Series-Parallel Hybrid Modes - Modal Control Strategies - Introduction to Electric Components & Drives used in Hybrid and Electric vehicles, Configuration and control of DC Motor drives – configuration and control of AC Motor drives, Configuration and control of Switch Reluctance Motor drive.		
Unit-V	BATTERY TECHNOLOGIES FOR ELECTRIC VEHICLE	9
Introduction - Power and Energy of Electric Propulsion - Basic Terms of Battery Performance and Characterization - Battery Charging Methods and EV Charging Schemes: Charging Methods - EV Charging Schemes - Basic Operation of a Rechargeable Battery - Battery Modeling - Current Status of Battery in Automobile Applications.		
Total Hours		45
Learning Resources		
Text books		
1	Mehrdad Ehsani, Yimin Gao and Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", 2nd Edition, CRC press, Florida, United States, 2010.	
2	Sira -Ramirez, Silva.R Ortigoza, "Control Design Techniques in Power Electronics Devices", 1st Edition, Springer, New York, 2006.	
Reference Books		
1	Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", 2nd Edition, CRC press, Taylor&Francis Group, Florida, United States, 2011.	
2	Chan C. C. and Chau K. T., "Modern electric vehicle technology", 1st Edition, Oxford University Press, New York, 2001.	
Web References		
1	https://onlinecourses.nptel.ac.in/noc20_ee18/preview	
2	https://www.coursera.org/learn/electric-vehicles-mobility	

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24OE628	Energy Technology	OE	3	0	0	3
Course Outcomes (s)						
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

Course Content		
Unit-I	INTRODUCTION	8
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources		
Unit – II	CONVENTIONAL ENERGY	8
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.		
Unit-III	NON-CONVENTIONAL ENERGY	10
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.		
Unit-IV	BIOMASS ENERGY	10
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, Pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.		
Unit-V	ENERGY CONSERVATION	9
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.		
Total Hours		45
Learning Resources		
Textbooks		
1	Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.	
2	Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.	
Reference Books		
1	Bansal, N.K., Kleeman, M. and Meliss, M., Renewable Energy Sources and Conversion Technology, 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.	
Web References		
1	https://onlinecourses.nptel.ac.in/noc24_ge51/preview	
2	https://onlinecourses.nptel.ac.in/noc20_ch37/preview	

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24OE629	Battery Management Systems	OE	3	0	0	3
Course Outcomes (s)						
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

Course Content		
Unit-I	ADVANCED BATTERIES	9
Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics-SOC,DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries-NCM and NCA Batteries. NCR18650B specifications.		
Unit – II	BATTERY PACK	9
Battery Pack- design, sizing, calculations, flow chart, real and simulation Model. Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.		
Unit-III	BATTERY MODELLING	9
Battery Modeling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons- Rint model, Thevenin model, PNGV model. State space Models- Introduction. Battery Modelling software/simulation frameworks.		
Unit-IV	BATTERY STATE ESTIMATION	9
SOC Estimation- Definition, importance, single cell Vs series batteries SOC. Estimation Methods- Load voltage, Electromotive force, AC impedance, Ah counting, Neural networks, Neuro-fuzzy forecast method, Kalman filter. Estimation Algorithms.		
Unit-V	BMS ARCHITECTURE AND REAL TIME COMPONENTS	9
Battery Management System- needs, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray- CANedge1 package. ARBIN Battery Tester. BMS Development with Modeling software and Model Based Design.		
Total Hours		45
Learning Resources		
Text books		
1	Jiuchun Jiang and Caiping Zhang, “Fundamentals and applications of Lithium-Ion batteries in Electric Drive Vehicles”, Wiley, 2015.	
2	Davide Andrea, “Battery Management Systems for Large Lithium-Ion Battery Packs” ARTECH House, 2010.	
Reference Books		
1	Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper	
Web References		
1	https://nptel.ac.in/courses/113105102	
2	https://archive.nptel.ac.in/courses/113/105/113105102/	

Course Code	Course Name	Category	Hours / Week			C
			L	T	P	
240E630	Power Converters For Electrical Appliances	OE	3	0	0	3
Course Outcome (s)						
Upon completion of the course students 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

Course Contents		
Unit-I	Introduction to Power Electronic Devices	9
Overview of Power Electronics – Definition, Need, and Applications Power Semiconductor Devices – Diodes, Thyristors (SCR), Power BJT, Power MOSFET, IGBT Switching Characteristics – Turn-on, Turn-off, Losses Basic Drive Circuits for Power Devices		
Unit-II	AC-DC Converters (Rectifiers)	9
Introduction to Rectifiers – Need and Types Single-Phase Rectifiers – Half-wave, Full-wave (Center-tap & Bridge)Ripple & Smoothing – Why capacitors are used (Like filtering noise in signals)Applications – Laptop adapters, USB chargers, PC power supplies, Applications – Battery Chargers, DC Power Supplies		
Unit-III	DC-AC Converters (Inverters)	9
Introduction to Inverters – Need and Types (Voltage Source & Current Source) Single-Phase Inverters – Half-bridge, Full-bridge (Square wave & PWM) Applications – UPS, Solar PV Systems, Motor Drives		
Unit-IV	DC-DC Converters (Choppers)	9
Introduction to DC-DC Converters – Need and Types Step-down (Buck) Converter – Operation and Waveforms Step-up (Boost) Converter – Operation and Waveforms Buck-Boost Converter – Operation and Applications – SMPS, Electric Vehicles, LED Drivers Applications –Smartphone fast charging, LED drivers, Laptop power management		
Unit-V	Power Converters in Smart Systems	9
Home Automation – How converters work in smart bulbs, Wi-Fi switches, Computer & IT Systems –SMPS (Switched Mode Power Supply) in PCs/Data center power backup systems Renewable Energy – Solar inverters, electric vehicle charging Future Trends – AI in power management, IoT-based energy saving		
Total Hours		45
Text books		
1	Power Electronics: Circuits, Devices and Applications, Muhammad H. Rashid, Pearson Education, 4th Edition, 2017	
2	Power Electronics, P.S. Bimbhra, Khanna Publishers,7th Edition, 2018	
Reference Books		
1	Power Electronics: Essentials and Applications L. Umanand Wiley India 1st Edition, 2009	
2	Power Electronics: Converters, Applications and Design, Ned Mohan, Tore M.Undeland, William P. Robbins, Wiley, 3rd Edition, 2002	
Web References		
1	https://nptel.ac.in/courses/108/105/108105066/	
2	https://www.allaboutcircuits.com/technical-articles/categories/power/	

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24OE631	FOUNDATION OF ROBOTICS	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 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						
C101.1	Interpret the features of robots and technology involved in the control.					[U]
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	FUNDAMENTALS OF ROBOT					9
Robot Definition, Robot Anatomy Co-ordinate systems, Work Envelope, classification – Requirements- Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load - 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 hazarded 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, "A textbook of Industrial Robotics", Lakshmi Publications, 2022.					

2	Mikell.P.Groover, "Industrial Robotics McGraw Hill 2ND edition 2012. Technology, Programming and applications"
3	
Reference Books:	
1	Fu K.S. Gonalz R.C. and ice C.S.G. "Robotics Control, Sensing, Vision and Intelligence". McGraw Hill book co. 2007
2	YoramKoren, "Robotics for Engineers", McGraw Hill Book, Co., 2002.
3	Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill 2005.
4	John. J.Craig, "Introduction to Robotics: Mechanics and Control" 2nd Edition, 2002.
5	Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer India reprint, 2010.
Web References:	
1	https://www.barnesandnoble.com/w/foundations-of-robotics-bruno-siciliano
2	https://www.foundations-of-robotics.org/?utm_source=chatgpt.com

Assessment based on Continuous and End Semester Examination						
Bloom's Level	Continuous Assessment			Assignm ent	Attenda nce	End Semester Examination
	CIA1 (6 Marks)	CIA2 (6 Marks)	Model Exam (8 Marks)			
Remember				(10 Marks)	(10 Marks)	(60 Marks)
Understand	4	2	2			
Apply	2	4	6			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
C101.1	√	√		√	√					√		√	√	√	
C101.2	√	√		√	√					√		√	√	√	
C101.3	√	√		√	√					√		√	√	√	
C101.4	√	√		√	√					√		√	√	√	
C101.5	√	√		√	√					√		√	√	√	

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
240E632	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, 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. 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	Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.					
Web References:						

1	https://dronelaunchacademy.com/
2	https://www.airsight.com/knowledge-hub/drone-basics

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

- 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	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
C101.1	√	√				√	√	√				√			
C101.2	√	√	√	√								√			
C101.3	√	√				√	√	√				√			
C101.4	√	√	√	√								√			
C101.5	√	√	√	√	√	√						√			

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24OE633	3D PRINTING	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 ScanSL, 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 Ceric Part Creation, Variants of Powder Bed Fusion Processes, Process Par3D Printingeters, 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 DFM 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		
Total Hours		45
Textbooks:		
1	Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.	
2	Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi.	
Reference Books:		
1	Chua Chee Kai, Leong Kah Fai, “Rapid Prototyping: Principles & Applications”, World Scientific,2003.	
2	Ali K. Kamrani, Emand Abouel Nasr, “Rapid Prototyping: Theory & Practice”, Springer, 2006.	
3	D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid prototyping and Rapid Tooling. Springer 2001.	

Assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			Assignment	Attendance	End Semester Examination
	CIA1 (6 Marks)	CIA2 (6 Marks)	Model Exam (8 Marks)			
Remember				(10 Marks)	(10 Marks)	(60 Marks)
Understand						
Apply						
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO 12	PS 01	PS 02	PS 03
C101.1	√	√	√	√										√	
C101.2	√	√	√	√								√		√	
C101.3	√	√	√	√								√		√	
C101.4	√	√	√	√								√		√	
C101.5	√	√	√	√								√		√	

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24OE634	DIGITAL MANUFACTURING	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 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 Mock up and Prototype 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 – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in 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”, A press, 2016.					
3						
Reference Books:						
1	Lihui Wang and Andrew YehChing 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.
Web References:	
1	https://link.springer.com
2	https://www.reddit.com
3	https://link.springer.com

Assessment based on Continuous and End Semester Examination

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

- 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	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
C101.1	√	√		√	√					√		√	√	√	
C101.2	√	√		√	√					√		√	√	√	
C101.3	√	√		√	√					√		√	√	√	
C101.4	√	√		√	√					√		√	√	√	
C101.5	√	√		√	√					√		√	√	√	

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
240E635	Composite Materials	PC	3	0	0	3
Regulation	Nature of the Course	Semester	Data Book/Codes/Standards			
R24A	THEORY		-----			
Pre-requisite Course(s)		Co-requisite Course(s)				
Course Objectives						
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.					
Course Outcomes						
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]
Course Contents						
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, Liquidmetal 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).						
Total Hours						45
Textbooks:						
1	K. K. Chawla, Composite Materials – Science and Engineering, Springer, 3rd Edition, 2012.					
2	Gibson, R. F., Principles of Composite Material Mechanics, CRC Press, 4th Edition, 2016.					
Reference Books:						
1	Mallick, P. K., Fiber-Reinforced Composites: Materials, Manufacturing, and Design, CRC Press, 3rd Edition, 2007.					

2	Mathews F.L., Rawlings R.D., Composite Materials: Engineering and Science, 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 (6 Marks)	CIA2 (6 Marks)	Model Exam (8 Marks)			
Remember				(10 Marks)	(10 Marks)	(60 Marks)
Understand	20	20	20			
Apply	30	30	80			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO3
C101.1	√						√								
C101.2	√	√					√								
C101.3	√	√	√		√							√			
C101.4	√	√	√	√	√							√			
C101.5	√				√		√					√			

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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 in 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 (Psycho analytic Theory), Perception – Meaning- Process- Factors affecting Perception. Learning – Meaning – Concepts –Factors affecting learning,						
Unit – 3						9
Motivation – Meaning- Theories (Maslow's, Herzberg's, Mc Gregors 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 th Edition, Pearson Education Ltd, 2022					
Reference Books:						
1	Aswathappa. K,“OrganizationalBehavior”, Himalaya Publishing House, 2024					
2	Fred Luthans, “OrganisationalBehaviour”, McGraw Hill Book Co.,14 th edition,2020					
Assessment based on Continuous and End Semester Examination						
Bloom’s 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%	100%			
	Apply					
	Analyze					
	Evaluate					
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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			

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24OE638	Total Quality Management	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 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 service 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.					
Course Outcomes 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 service sectors.					[U]
Course Contents						
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 - Barriers 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
The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology,						

applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, 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.

Total Hours **45**

Textbooks:

- | | |
|---|--|
| 1 | Dale H.Besterfield, Carol B.Michna, Glen H. Besterfield, Mary B.Sacre, Hemant Urdhwarehe and RashmiUrdhwarehe, “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. |

Reference Books:

- | | |
|---|--|
| 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. |

Web References:

- | | |
|---|---|
| 1 | https://www.youtube.com/playlist?list=PL2H1ILi34F7gRnoyJer96C5R4dG48G6eO |
| 2 | https://www.youtube.com/watch?v=OSz7MvkPhFI |
| 3 | https://www.youtube.com/playlist?list=PL8fPvgxF8y0XY6AKVJMq9V_fbT0clL6N_ |

Assessment based on Continuous and End Semester Examination

Bloom’s 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%		80%			
Apply	20%	100%	20%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
OE638.1	-	2	2	-	-	-	3	-	2	-	-			
OE638.2	-	-	2	1	-	2	2	-	2	-	-			
OE638.3	-	3	1	1	2	-	-	-	3	-	-			
OE638.4	-	-	1	1	-	2	-	-	1	-	-			
OE638.5	-	-	2	-	2	-	-	-	-	-	-			

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Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24OE639	Intellectual Property Rights	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 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					[U]

	Act, Trademark Act, and Geographical Indication Act.	
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 copy rights, 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 IPRS	9
Infringement of IPRs, 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	https://www.youtube.com/watch?v=IlXGjaCkM6Y
2	https://www.youtube.com/watch?v=pqRqJ3e4PUE
3	https://www.youtube.com/watch?v=Oj_VwmI-Q18

Assessment based on Continuous and End Semester Examination

Bloom's 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 %	100 %				
Apply			100%			
Analyze						
Evaluate						
Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	P O1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
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	-	-	-

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Approved by

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					[U]

	business.	
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 (6 Marks)	CIA2 (6 Marks)	Model Exam (8 Marks)	(10 Marks)	(10 Marks)	(60 Marks)
Remember				10	10	60
Understand	100%	100%	80%			
Apply			20%			
Analyze						
Evaluate						

Create						
Total (100 Marks)	6	6	8	10	10	60

- 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
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	-	-	-

Prepared by

Approved by

Course Code	Course Name	Semester	Category	Hours/Week			C
				L	T	P	
24OE641	Algebra and Number Theory	---	OEC	3	0	0	3
Course Outcomes (s)							
Upon completion of the course, students shall have ability to							RBT
CO1	Apply algebraic structures and mappings to solve problems related to groups and rings.						[AP]
CO2	Utilize properties of finite fields to analyze and factor expressions within polynomial systems.						[AP]
CO3	Implement number-theoretic techniques from divisibility and decomposition to perform structured arithmetic computations.						[AP]
CO4	Solve modular equations and systems using methods from Diophantine analysis and congruences.						[AP]
CO5	Apply classical results and arithmetic functions to evaluate and reason about numerical properties.						[AP]
Course Content							
Unit – I	GROUPS AND RINGS						9
Groups: Definition - Properties - Homomorphism - Isomorphism - Cyclic groups - Cosets - Lagrange's theorem. Rings: Definition - Sub rings - Integral domain - Field - Integer modulo n - Ring homomorphism.							
Unit – II	FINITE FIELDS AND POLYNOMIALS						9
Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.							
Unit– III	DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS						9
Division algorithm- Base-b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM.							
Unit– IV	DIOPHANTINE EQUATIONS AND CONGRUENCES						9
Linear Diophantine equations – Congruence's – Linear Congruence's - Applications : Divisibility tests - Modular exponentiation - Chinese remainder theorem – 2x2 linear systems							
Unit – V	CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS						9
Wilson's theorem – Fermat's Little theorem – Euler's theorem – Euler's Phi functions – Tau and Sigma functions.							
						TOTAL: 45 Hours	
Learning Resources							
Textbooks							
1	R. P. Grimaldi and B. V. Ramana, <i>Discrete and Combinatorial Mathematics: An Applied Introduction</i> , 5th ed. New Delhi, India: Pearson Education, 2019.						
2	T. Koshy, <i>Elementary Number Theory with Applications</i> , 2nd ed. Burlington, MA, USA: Academic Press, 2007.						
Reference Books							
1	S. Ling and C. Xing, <i>Coding Theory: A First Course</i> , 1st ed. Cambridge, U.K.: Cambridge University Press, 2004.						
2	I. Niven, H. S. Zuckerman, and H. L. Montgomery, <i>An Introduction to the Theory of Numbers</i> , 5th ed. Singapore: John Wiley and Sons, 2004.						
3	R. Lidl and G. Pilz, <i>Applied Abstract Algebra</i> , 2nd ed. New Delhi, India: Springer-Verlag, 2006.						

Reference Books	
1	B. Kolman and D. R. Hill, <i>Introductory Linear Algebra</i> , 8th ed. New Delhi, India: Pearson Education, 2009.
2	S. Kumaresan, <i>Linear Algebra: A Geometric Approach</i> , Reprint, New Delhi, India: Prentice Hall of India, 2010.
3	R. Bronson, <i>Schaum's Outline of Matrix Operations</i> , 2nd ed. New York, NY, USA: McGraw-Hill, 2011.
4	G. Strang, <i>Linear Algebra and Its Applications</i> , 5th ed. New Delhi, India: Pearson Education, 2023.
5	V. Sundarapandian, <i>Numerical Linear Algebra</i> , New Delhi, India: PHI Learning Pvt. Ltd., 2023.
Web References	
1	https://archive.nptel.ac.in/courses/111/106/111106051
2	https://onlinecourses.nptel.ac.in/noc24_ee48/preview
3	https://archive.nptel.ac.in/courses/111/107/111107106/

Course Code	Course Name	Semester	Category	Hours/Week			C
				L	T	P	
24OE643	Advanced Engineering Chemistry		OE	3	0	0	3
Course Outcomes (s)							
Upon completion of the course, students shall have ability to							RBT
CO1	Understand the basic principles of semiconductors, including periodic trends, band gaps, conductivity, and their applications in various electronic and optoelectronic devices.						[U]
CO2	Select appropriate modern engineering alloys based on their composition and properties for specific applications in electronics, telecommunications, and aerospace.						[AP]
CO3	Classify different types of refractories and abrasives and describe their properties and manufacturing processes with respect to industrial usage.						[U]
CO4	Describe the types and mechanisms of adsorption, interpret adsorption isotherms, and explain their significance in catalytic and surface chemistry applications.						[U]
CO5	Apply suitable spectroscopic techniques such as UV-Visible, IR, XRD, and flame photometry for the qualitative and quantitative analysis of materials.						[AP]

Course Content		
Unit – I	Chemistry of Semiconductors	9
Semiconductors – Introduction – Periodic trends –Band gaps, conductivity and colours of semiconductors - compound semiconductors–Semiconductor Technology – An overview of Integrated circuit design and fabrication – uses in FET – BJT, JFET, MOSFET - Semiconductors in traffic lights and electronics, CD/DVD optical discs, microchips in computers and cell phones, solar cells- amorphous semiconductors – an overview		

Unit – II	Modern Engineering Materials	9
Metals and Metallic properties-Alloys and Need for Alloys - Modern Electronic grade alloys-Composition, Properties of Aluminium, Silicon, Nickel, Phosphorus and Copper alloys-Applications in electrical components, transducers, electromagnetic shielding of computers, telecommunications equipment and rocket motor casings.		
Unit – III	Refractories and Abrasives	9
Refractories – classification – acidic, basic and neutral refractories – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) – manufacture of alumina, magnesite and zirconia bricks. Abrasives – natural and synthetic abrasives – quartz, corundum, emery, garnet, diamond, silicon carbide and boron carbide.		
Unit – IV	Surface Chemistry	09
Adsorption- Classification of adsorption-adsorption of gases on solids-adsorption of solutes from Solutions-Types of adsorption isotherms-Freundlich adsorption Isotherm-Langmuir’s theory of adsorption- Applications of adsorption - Role of adsorbents in catalysis.		
Unit – V	Spectroscopic Techniques	09
Basic concepts of spectroscopy - Electromagnetic spectrum – Lambert and Beers law - Absorption and Emission spectroscopy – Different spectroscopic Techniques - UV- Visible – IR – Colorimetry - Flame photometry (Block Diagram) - XRD technique.		
		TOTAL: 45 Hours
Learning Resources		
Textbooks		
1	David W. Greve, “Semiconductor Devices and Technology”, Squirrel Hill Publications, Pittsburg, USA, 14th Edition, 2011.	
2	Jain P. C. & Monica Jain., “Engineering Chemistry”, 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.	
3	Dara S.S., “A Text book of Engineering Chemistry”, S.Chand Publications, 2004	
4	Shashi Chawla “A Text Book Of Engineering Chemistry” Dhanpat Rai & Co. (P) Limited, 2017	
Reference Books		
1	Joel Irwin Gersten and Frederick William Smith, “The Physics and Chemistry of Materials”, Wiley Interscience, New Jersey, 12th Edition, 2012.	
2	Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.	
3	Friedrich Emich, “Engineering Chemistry”, Medtech, 2014.	
Web References		
1	https://learncheme.com/	
2	https://www.coursera.org/browse/physical-science-and-engineering/chemistry	
3	http://www.cheresources.com/	

Course Code	Course Name	Semester	Category	Hours/Week			C
				L	T	P	
24OE644	Nanotechnology And NLO Materials		OE	3	0	0	3
Course Outcomes (s)							
Upon completion of the course, students shall have ability to							RBT
CO1	Understand the basic concepts of nanotechnology.						[U]
CO2	Explained the method of synthesizing nanostructures with desired size, shape, and surface properties.						[AP]
CO3	Apply characterization results to optimize the synthesis process and enhance the functionality of nanomaterials for targeted applications.						[AP]
CO4	Utilize nanomaterials for the design of high-performance sensing devices.						[AP]
CO5	Utilize nonlinear optical concepts to enhance and develop technologies in recent engineering.						[AP]

Course Content		
Unit – I	INTRODUCTION TO NANOMATERIALS	9
History of nanomaterial's, Classification of Nanomaterial's, Scientific Revolutions, Nanotechnology and Nano machines, The Periodic Table, Atomic Structure, Energy, Molecular and Atomic size, Surfaces and Dimensional Space.		
Unit – II	SYNTHESIS METHOD OF NANO MATERIALS	9
Top down and Bottom-up approach, Ball Milling, Electros pinning, 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, Electro deposition.		
Unit – III	BASICS OF NANO MATERIALS CHARACTERIZATION TECHNIQUES	9
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.		
Unit – IV	NANO MATERIALS AND APPLICATIONS	9
Sensors, Nanotechnology Enabled Sensors, Sensor Characteristics and Terminology, Static Characteristics, Dynamic Characteristics, Resistive and Capacitive Gas Sensors, Potentiometric Sensors, Amperometric Sensors, Electro-Chemical Biosensors.		
Unit – V	NONLINEAR OPTICS AND APPLICATIONS	09
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.		
		TOTAL: 45 Hours
Learning Resources		
Textbooks		
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 Grundler, 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.
Reference Books	
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 Nano science, S.M. Lindsay, Oxford university Press, 2010.
6	Encyclopedia of Nano Technology by M. Balakrishna Rao and K. Krishna Reddy, Vol I to X, Cumpus Books International, 2006.
7	A practical approach to X-Ray diffraction analysis by C. Suryanarayana, Plenum Press, Newyork, 1998.
8	Atomic and Molecular Spectroscopy: Basic Aspects and Applications by S. Svanberg, Springer, 2001.
Web References	
1	https://archive.nptel.ac.in/courses/118/102/118102003/#
2	https://archive.nptel.ac.in/courses/115/105/115105105/
3	https://archive.nptel.ac.in/courses/115/101/115101008/#
4	https://ocw.mit.edu/courses/2-57-nano-to-macro-transport-processes-spring-2012/resources/lecture-1-intro-to-nanotechnology-nanoscale-transport-phenomena/

Course Code	Course Name	Category	Hours/Week			C
			L	T	P	
24OE645	English for Competitive Examinations	HS	3	0	0	3
Course Outcomes (s)						
Upon completion of the course, students shall have ability						RBT
C114.1	Understanding of common English words and phrases, building their vocabulary to communicate.					AP
C114.2	Recognize different types of sentence structures.					AP
C114.3	Learn to write précis and notes with clarity.					AP
C114.4	Express ideas in a clear and concise manner.					AP

C114.5	Gain a clear understanding in the use of prepositions and eliminate common errors.	AP
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Course Content		
Unit –1	INTRODUCTION TO BASICS OF ENGLISH	9
Different kinds of Tenses, Types of Sentences, Phrase, Adverb& Phrases and Idioms. Synonyms and Antonyms.		
Unit –2	TRANSFORMATION OF SENTENCE	9
Transformation of simple, Compound and complex sentences, Transformation of communication classification of sentences & Transformation of Degree. Synonyms And Antonyms.		
Unit –3	PRECIS AND NOTE WRITING	9
Precise writing, Note making, Paragraph Writing & Essay Writing. Synonyms And Antonyms.		
Unit –4	COMPREHENSION AND LETTER AND REPORT WRITING	9
Comprehension, Letter Writing &Report Writing. Synonyms And Antonyms.		
Unit –5	COMMON ERRORS AND USE OF PREPOSITIONS	9
Match Words With Their Meanings, Spotting Common Errors In English Grammar, Appropriate Use Of Prepositions. Synonyms And Antonyms.		
		TOTAL: 45Hours
Learning Resources		
Textbooks		
1	K. S. Sinha, <i>The King’s Grammar</i> . New Delhi, India: Blackie ELT Books, 2008.	
2	C. D. Sidhu, P. Nath, and K. Kapoor, <i>Comprehensive English Grammar and Composition</i> . New Delhi, India: Khosla Publishing House, 2004.	
3	P. C. Wren and H. Martin, <i>High School English Grammar & Composition</i> . New Delhi, India: S. Chand & Company, 2007.	
Reference Books		
1	C. Baldick, <i>The Oxford Dictionary of Literary Terms</i> . Oxford, U.K.: Oxford University Press, 2009.	
3	J. Mathew, <i>Fine Tune Your English</i> . New Delhi, India: Orient Blackswan Pvt. Ltd., 2010.	
Web References		
1	https://byjus.com/govt-exams/general-english-competitive-exams//	